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"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish, if such communications shall be long intermitted: and it will die away, if they shall entirely cease."

SIR WM. JONES.

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all, with the exception of Sir George Everest,* approved of the proposed plan of carrying them out; several made very valuable suggestions.

The Secretary of State in Council consequently sanctioned the experiments, and on Colonel Walker's recommendation he directed Captain Basevi, R. E., who was then in England on furlough, to proceed to Kew to learn the use of the Pendulum and apparatus, with the view of his conducting the experiments in India.

Before detailing the proposed operations, a sketch of the theory, and of what has hitherto been done in the way of Pendulum experiments, may be interesting. The application of Pendulum experiments to determine the figure of the earth, is based upon a theorem demonstrated by Clairaut, which may be stated thus, that the sum of the ellipticity† of the earth, and the fraction expressing the ratio of the whole increase of gravity to the equatorial gravity is a constant quantity, and is equal to $\frac{5}{2}$ of the ratio of the centrifugal force to the force of gravity at the equator. Hence by ascertaining the difference between the polar and equatorial gravity, or, which is the same thing, the progressive increase in the force of gravity in going from the equator towards the pole, the ellipticity of the earth is at once determined.

It is proved in mechanics that the forces of gravity, at any two stations on the earth's surface, are proportional to the lengths of the seconds Pendulum at those stations, or to the squares of the number of vibrations made by the same pendulum in any given time, one solar day for instance. Here is at once an easy means of determining the variations in the force of gravity, and the solution of the problem of the earth's ellipticity is reduced to the measure of the length of the seconds pendulum at a number of points on the earth's surface, or, as has been most generally done, to the observation of the number of oscillations made by the same pendulum in a mean solar day.

This theory, however, supposes the pendulum to be a "simple pendulum" that is, to consist of a material point suspended by a string without weight, which is, of course a practical impossibility; but as

* Sir G. Everest proposed to employ only the Pendulum of an astronomical clock, but this method is objectionable, as the Pendulum cannot be said to be acted on solely by gravity.

† The ellipticity or compression, as it is sometimes called, is the fraction whose numerator is the difference between the polar and equatorial semi-diameters, and the denominator is the equatorial semi-diameter.

it is always possible to calculate the length of the simple pendulum which would vibrate in the same time as a given compound pendulum, the latter may be used for precisely the same purpose as the former.

Besides this, there are several other conditions supposed to hold good, which in practice are never attained, viz. the arc of vibration has been assumed to be indefinitely small, the length of the pendulum to be constant, *i. e.* unaffected by temperature, and the oscillations made in vacuo and at the level of the sea. Corrections have therefore to be computed and applied to the observations, for each of these assumptions.

The time of vibration* in a circular arc is expressed in terms of the length of the pendulum, the force of gravity, and a series of ascending powers of the arc of vibration. The arc is always small, but still not so small that the terms depending on it can be wholly neglected; the first term, however, of the series is all that is ever appreciable in practice. Again, the observations are generally continued for a considerable time, and the change in the arc of vibration has to be taken into account. It has been shewn mathematically, on a certain supposition regarding the resistance of the air, and found to be the case practically, that the arc decreases in a geometric ratio, whilst the times increase in an arithmetic ratio, and on this principle the correction† to the observed time of oscillation is computed.

Secondly, a correction must be applied for the temperature of the pendulum: a change of temperature will, of course, by altering the length of the pendulum, affect the time of its vibration. This cor-

* $$t = \pi \sqrt{\frac{l}{g}} \left\{ 1 + \left(\frac{1}{2}\right)^2 \operatorname{Sin}^2 \frac{\alpha}{2} + \left(\frac{1.3}{2.4}\right)^2 \left(\operatorname{Sin}^2 \frac{\alpha}{2}\right)^2 + \ldots \ldots \left(\frac{1.3.5 \ldots (2n-1)}{2.4.6 \ldots 2n}\right)^2 \left(\operatorname{Sin}^2 \frac{\alpha}{2}\right)^n \right\}$$

in which t = time of one oscillation.
π = semi-circumference of a circle whose radius is unity.
l = length of the Pendulum.
g = force of gravity.
α = arc of semi-vibration.

† The formula for this correction is

$$n \frac{M}{32} \cdot \frac{\operatorname{Sin}(A + a) \operatorname{Sin}(A - a)}{\operatorname{Log} \operatorname{Sin} A - \operatorname{Log} \operatorname{Sin} a} \text{ in which}$$

n = number of oscillations made in a day; M = logarithmic modulus = 0.4342945; A the *initial*, and a the final semi-arcs of vibration. Correction always additive.

rection* must be determined experimentally. Captain Kater immersed his pendulum in fluids of different temperatures, and measured with a micrometric arrangement the alterations in its length. Captain (now General) Sabine observed the change in the number of vibrations made by a pendulum in different temperatures. This is the most direct method of obtaining the correction undoubtedly, but everything depends on the perfect compensation of the clock pendulum with which it is compared.

Thirdly, the formula is only true for observations in a vacuum, and as observations have generally been made in air, or at all events only in a partial vacuum, the effect of the air has to be taken into account. This effect is to diminish the weight of the pendulum by the weight of the air displaced, or to diminish the apparent force of gravity in the same proportion. In the very large majority of observations, the correction has been computed on this consideration solely; but Bessel demonstrated in 1828† that this correction was insufficient, inasmuch as a portion of the surrounding air was set in motion by, and moved with, the pendulum so as to become part of the moving mass. The correction for this can only be determined practically, as by swinging the pendulum in "media" of different densities. It depends chiefly on the form of the pendulum. As this correction, "reduction to a vacuum" or "buoyancy correction" as it is

* According to Kater's method—if τ be the standard temperature which is generally taken as 62° Fahrenheit; t the observed temperature of the pendulum; f its factor of expansion for 1° Fahrenheit, then correction $= \frac{1}{2}\ n.\ f.\ (t-\tau)$ positive when $t > \tau$.

† This circumstance was most clearly pointed out by the Chevalier du Buat in 1786, who made a number of experiments with pendulums formed of different substances, but his researches, which created a great sensation at the time, appear to have been completely lost sight of, and to have been unknown even to Borda, who was conducting his experiments, little more than ten years after the publication of Du Buat's results.

The *true* correction for buoyancy Mr. Baily has shown to be (Phil. Trans. 1832)

$$C + \frac{\beta}{1 + .0023\ (t - 32°)}$$ where β is the height of Barometer, and t the temperature during the interval of observation. C is a *constant* for the *same pendulum* and is determined from the formula

$$C = \frac{N'' - N'}{\beta' - \beta''}\left[1 + .0023\ (t° - 32°)\right]$$ in which N' is the number of vibrations in a mean solar day, β' and t' the barometer and thermometer readings, *in air*; and N'', β'', t'' the same quantities in a *highly rarified medium* $t' = \frac{1}{2}\ (t° + t'')$

called, depends also on the state of the atmosphere, it is necessary for its calculation, to record the readings of the barometer, when the observations are taken in air.

The last correction is for the height of the station of observation above the mean sea level. The force of gravity varying inversely as the square of the distance from the earth's centre, a pendulum swung at a certain elevation above the sea, will make fewer oscillations in a day than at the level of the sea, and a correction has to be added on this account. Dr. Young, however, demonstrated that the correction computed on this consideration alone, was too large, as it neglected the attraction of the elevated mass itself, and he showed how this might be approximately allowed for.*

The general principle followed in determining the length of the seconds pendulum, is to observe the number of vibrations made by a pendulum of known length, in a mean solar day; then the length of the seconds pendulum is found by multiplying the length of the given pendulum, by the square of the number of its vibrations in a day, and dividing by the square of the number of seconds in a day.

The number of vibrations is generally determined by the method of coincidences. The detached pendulum is placed in front of a good clock, and adjusted to such a length as to gain or lose, (the latter generally) two beats upon the clock in some convenient time, 5 to 10 minutes. Suppose the pendulums to be started together, then the longer one of the two will be left behind by the other, the distance between them continually increasing, until at length they will be at opposite extremities of their arcs of vibration at the same moment: the longer pendulum has now lost one oscillation on the shorter one, and both are apparently going at the same rate, but in opposite directions; after a short time they will begin to approach each other, the distance between them gradually diminishing, until they both appear to coincide. It is clear that between two consecutive coincidences the

* This correction is given by the formula $\left(\frac{n}{r}\right) h\ x$, where n denotes the number of oscillations in a mean solar day, r the radius of the earth at the given station, h the height of the station above the mean level of the sea: x is an unknown quantity determinable from theory; on the assumption that the mean density of the earth is 5.5 and that of the surface 2.5 Dr. Young (Phil. Transactions 1819) showed that the correction for a station on a tract *of table* land would be reduced by $\frac{1}{3}$rd or that the correction $= \frac{2}{3}\ n\ h$.

longer pendulum will have lost two oscillations on the shorter one. Hence all that is requisite in practice, is to observe as accurately as possible the intervals between the successive coincidences; the number of vibrations made by the clock pendulum is determined by observations of the sun or stars, and then the number made by the detached pendulum is computed by simple proportion.*

The first pendulum observations of which any account is preserved are those made by Picard at Paris and Uranienburg (Tycho Brahe's observatory) and those by Richer at Cayenne in 1672. These last observations are said to have attracted Newton's attention, as they proved the variation in the length of the seconds pendulum in different latitudes, and it is generally stated that Richer made the discovery by accident. But it appears from Picard's address to the French academy in 1671, that a variation had been already observed, and it is probable that Richer's mission was undertaken partly with a view to throw light on the subject. Picard stated that "from observations made at London, Paris and Bologna, it would seem as if the seconds pendulum required to be shortened in approaching the equator, but that on the other hand, he is not sufficiently convinced of the accuracy of those measurements, because, at the Hague, the length of the seconds pendulum was found to be quite the same as at Paris, notwithstanding the difference of latitude."†

Near the end of the 18th century, Borda made his celebrated experiments for determining the length of the seconds pendulum at Paris. His apparatus, which is named after him, consisted of a spherical ball of platinum attached by grease to a brass cap which had been truly ground, so as to fit it perfectly. The object of this attachment was to enable the observer to turn the ball round in the cap at pleasure, so as to destroy the effects of unequal density in different parts of it. A fine wire carrying the cap was fastened to the lower end of a small cylinder, passing through the knife edge, which carried on its upper end a small moveable weight, by adjusting which the knife edge and cylinder could be made to vibrate independently in the same

* If r = daily rate of the clock and I the mean interval of the coincidences, then the number of oscillations made by the pendulum in a day = n

$$n = \frac{I-2}{I}(86400 \pm r)$$ the lower sign is to be used when the clock is *losing*.

† Cosmos Vol. IV. page 25, Sabine's translation.

time as the pendulum, so that their effect might be neglected in computing the length of the simple pendulum. When in use, the knife edge rested upon a steel plate. The number of vibrations per diem was ascertained by means of a clock, but Borda made a great improvement on the old method of *counting* the coincidences. He fixed a straight edge vertically, so as to coincide with the pendulum wire at rest, when seen through a telescope placed opposite. A cross was made on the bob of the clock pendulum, and the observation consisted in noting the times when the wire and cross disappeared together behind the edge. After a series of coincidences had been observed, the length of the pendulum was measured by means of a horizontal steel plate, which was screwed up from below, so as just to touch the ball: then the pendulum was removed, and a bar, whose length had been carefully compared with a standard, inserted in its place. The bar had a T-head, of which the lower surface rested on the upper steel plate, and a graduated rod, sliding on the bar, was adjusted to contact with the lower plate. The diameter of the platinum ball was then measured by means of the same slider, by placing it on the steel plate for the purpose; the brass cap and wire were then weighed. The apparatus was enclosed in a glass case, and the temperature was carefully recorded. All necessary corrections were applied, excepting the true one for buoyancy. The whole process, which required very great delicacy, had to be repeated, and the length of the corresponding simple pendulum computed after each series of observations. Borda's pendulum was about 12 feet in length.

His method was followed by M. M. Arago, Biot, and Chaix, at Formentera, the southernmost station of the French arc, with this exception that they used a pendulum of only 3 feet in length These observations were extended by Biot in 1817 to Leith, and Unst in the Shetlands, and in conjunction with M. Mathieu, he observed at Dunkirk, Paris, Clermont, Bordeaux, and Figeac. From these operations; Biot deduced an ellipticity of $\frac{1}{304}$.

In about 1809, Captain Warren made some observations at the Madras observatory with a pendulum formed of a leaden ball suspended by a fibre made from the plantain leaf. The vibrations were counted and an assistant noted the times, from an astronomical clock. In order to measure its length, he attached some glass plates to a wall, and set

off on them a scale, transferred from Colonel Lambton's scale; the length was then measured by a pair of beam compasses. The length of the seconds pendulum was found to be 39.0263 inches of this scale *in air*.

In 1818, Captain Kater published his determination of the length of the seconds pendulum in London at Mr. Browne's house, Portland Place, taken for the purpose of fixing the standard of English measures. His method was founded on the dynamical theorem due to Huyghens, that the centre of oscillation, and axis of suspension, are reciprocal in the same body; that is, if the body be suspended at its centre of oscillation, the former axis of suspension will pass through the new centre of oscillation, and the body will vibrate in the same time as before. The distance from the axis of suspension to the point called centre of oscillation, is equal to the length of the simple pendulum.

Captain Kater's pendulum consisted of a bar of plate brass 1.6 inches broad and ⅛th of an inch thick: two knife edges of the hardest steel, attached to solid pieces of brass, were fixed to the bar at a distance of rather more than 39 inches from each other; when the pendulum was in use, these knife edges rested on horizontal planes of agate. At one end of the bar, immediately below the knife edge, was a large flat brass bob firmly soldered to it; and on the bar, between the knife edges, were two sliding weights. The plan of operations was to observe the number of vibrations per diem, made by the pendulum when suspended, first, by one knife edge, and then by the other; and if these numbers were not identical, to make them so, by means of the sliding weights. The distance between the knife edges, that is, the length of the corresponding simple pendulum, was then measured by a micrometric arrangement. The method of observing the number of vibrations was as follows; to each extremity of the pendulum, a light deal tail-piece, well blackened, was attached; and on the bob of the clock pendulum a white paper disc, equal in diameter to the breadth of the tail-piece, was fastened; the detached pendulum was now placed in front of the clock, and both pendulums being at rest, a telescope was alined, so that the blackened tail-piece exactly covered the paper disc. The telescope was also fitted with a diaphragm, consisting of two perpendicular cheeks, which could be adjusted so as to

become tangents to the disc. Now, if both pendulums be set in motion, the detached pendulum vibrating slower than the clock one, the tail-piece will be seen to pass across the diaphragm, followed by the white disc; at each succeeding vibration the disc follows closer and closer, first touching it, and at last becoming completely eclipsed by it. The exact time of this event, called a "disappearance," is noted; after a few more vibrations, the disc will reappear *preceding* the tail-piece; the time of this event, called the "reappearance," is also noted; and the mean of the disappearance and reappearance is taken as the true time of coincidence. It is immaterial in this method of observation, whether the detached pendulum vibrates faster or slower than the clock pendulum, but it is a *sine quâ non* that its arc of vibration be less. The result, introducing all corrections, except the true one for buoyancy, was 39.13929 inches, which is still the received length, although General Sabine, in 1831, showed, by swinging the pendulum in air and in vacuo, that the buoyancy correction was different, according as the heavy weight was above, or below, the plane of suspension.

Captain Kater, in the following year, 1818, made a series of experiments at the principal stations of the English Survey, from Shanklin in the Isle of Wight, to Unst in the Shetlands. He used in these observations a pendulum of a different pattern, known as "Kater's invariable pendulum." With it, it is not possible, nor was it intended, to determine the length of the seconds' pendulum, but it is essentially a differential instrument, and is used for measuring the differences in the number of vibrations at different stations. With these differences, if at any one station the length of the seconds' pendulum has been already determined, the corresponding lengths at the other stations can be ascertained. The invariable pendulum is of the same dimensions as the convertible one, but is without the second knife edge, and tail-piece, and the sliding weights. The mode of observation is exactly the same. Captain Kater deduced values of the ellipticity, from consecutive pairs of stations; he considered $\frac{1}{304}$ as a probable value (the same as M. Biot's); but he remarks on the difficulty of deriving a satisfactory determination, unless the extreme stations comprise an arc of sufficient extent to render the effects of irregular local attraction insensible.

In 1821-22, some very good observations were made by Mr. Goldinghom, at Madras, and afterwards at a small island called Pulo Gaunsah Lout, lying nearly on the equator in East Longitude 98° 50′. The pendulum used was an invariable one, and observations were first taken with it in London, by Captain Kater. From the observations at Madras and London, Mr. Goldingham deduced an ellipticity of $\frac{1}{297}$.

Captain Basil Hall, assisted by Captain (then Lieutenant) Henry Foster, made a series of experiments with an invariable pendulum in 1820-23, at Galapagos, San Blas (Mexico), Rio Janeiro, and London (Mr. Browne's house). Comparing the results at each of his own stations, with each of Captain Kater's, he deduced ellipticities of $\frac{1}{285}$, $\frac{1}{314}$, and $\frac{1}{302}$.

In 1822, Sir Thomas Brisbane took with him to Paramatta (near Sydney,) an invariable pendulum that had previously been swung in London, at Mr. Browne's house. He deduced ellipticities of $\frac{1}{296}$ and $\frac{1}{304}$, comparing his observations with those of Kater in London and at Unst.

In 1817, the French Government fitted out a scientific expedition under the command of Captain Freycinet, who was furnished with three invariable brass pendulums, one of which was similar to Captain Kater's pattern, and the other two had solid cylindrical rods instead of a flat bar. He had also a fourth pendulum, with a wooden rod formed of two plates of deal firmly clamped together. Instead of a clock he used an astronomical counter, ("compteur astronomique") whose beats could be adjusted to synchronism with those of the pendulum. The counter had a dial, which showed hours, minutes, and seconds, so that by comparing the time shown by this "compteur" with that of a chronometer, he obtained the number of vibrations made by the pendulum in a certain interval, generally an hour or 40 minutes. The pendulums were first swung at Paris, and afterwards at Rio Janeiro, Mauritius, Guam (one of the Ladrone Islands), Mowi (one of the Sandwich Isles), Cape of Good Hope, Port Jackson, Ravak (an island under the line, north of New Guinea), and Malouine or Falkland Isles. Rejecting the determinations at the Mauritius, Guam and Mowi, as they appeared affected to a remarkable degree by local influences, Captain Freycinet deduced an ellipticity of $\frac{1}{286}$ from all four pendulums.

On the return of Captain Freycinet, the French government sent out another expedition under Captain Duperrey. He was supplied with two of Captain Freycinet's brass pendulums, viz. one with a cylindrical rod, and the one on Kater's principal. He observed at six stations, viz. Ascension, Mauritius, Port Jackson, Falkland Isles, Toulon, and Paris. In deducing the ellipticity, he combined his results with those of Freycinet only, and obtained values varying from $\frac{1}{266}$ to $\frac{1}{290}$.

During Ross's voyage to Baffin's Bay in 1818, some observations were taken at Brassa, in the Shetlands, and at Hare Island, with a clock fitted with an invariable pendulum vibrating on a knife edge, which rested on hollow agate cylinders. Observations were repeated at these stations, and a further set taken at Melville Island, on Captain Parry's first voyage to the North Pole in 1819-20. Captain Sabine conducted both these experiments, using the same instruments.

In 1822, the English Government sent out an expedition under Captain, now General, Sabine, for the purpose of extending the enquiry commenced by Captain Kater; for both Kater and Biot had come to the conclusion, from a discussion of the experiments, that no decisive result of the earth's ellipticity could be obtained from them, on account of the smallness of the comprised arc, and the variations of local density. Captain Sabine visited thirteen stations between Bahia, S. Lat. 12° 59′ to Spitzbergen N. Lat. 79° 50′. He had with him three pendulums of Kater's invariable pattern, which were all swung at each station. Besides these he had the two clocks and attached pendulums which he had already used on his arctic voyages. His method of observation was similar to Captain Kater's; all the pendulums were swung in London at Mr. Browne's house, both before and after the expedition.

The ellipticity deduced from the experiments at Captain Sabine's stations was $\frac{1}{288 \cdot 4}$, from the same combined with Kater's $\frac{1}{289 \cdot 5}$, and combined again with Biot's $\frac{1}{288 \cdot 6}$, and from a general combination of all of these, $\frac{1}{289 \cdot 1}$. The observations of the *detached* pendulums only were used in these determinations; for though the clock pendulums gave closely coinciding values of ellipticity, still being acted on by other forces than gravity, their results are less reliable, and are only valuable in so far as they afford an independent corroboration of the other results.

Captain Sabine was not at first aware of the strict expression for the reduction to a vacuum, but after the publication of Bessel's observations in 1828, he had an apparatus specially constructed, and ascertained the proper correction practically, by swinging his pendulums in air, and in vacuo.

The error from this cause, however, proved to be trifling, owing to his observations being strictly differential, so that only the differences between the corrections by the old and new formulæ entered.

The most widely differing buoyancy corrections at any of his or Captain Kater's stations of observation, computed by the old formula were + 5.75 vibrations at Sierra Leone, and + 6.27 vibrations at Spitzbergen, in a mean solar day. These corrections, multiplied by the proper factor, 1.65, to reduce them to the new formula, became + 9.52 and + 10.38 vibrations, so that the number of vibrations in a mean solar day at Sierra Leone required to be increased by (9.52—5.75) 3.77, and at Spitzbergen by (10.38—6.27) 4.11 vibrations. But the acceleration between the stations would only be *increased* by the difference between these numbers, or by 0.44 vibrations. It so happened, however, that even this difference was too large, for in the deduction of the temperature correction, the old buoyancy formula had of course been used; on applying a correction on this account, the above difference required to be *reduced* by 0.36 vibrations, so that the whole error on the acceleration of the pendulum between Sierra Leone and Spitzbergen was only + .08 vibrations.

Captain Sabine subsequently determined the difference in the number of vibrations made by an invariable pendulum between London and Paris, London and Greenwich, and London and Altona. He also determined the true buoyancy correction for Kater's convertible pendulum.

In 1825 M. Bessel made his experiments for determining the length of the seconds' pendulum at Königsberg, with an apparatus constructed and partly designed by Repsold, the celebrated artist of Hamburg. The apparatus was contrived so as to avoid any uncertainty in the centre of oscillation of the pendulum, as well as any error in the measure of its length, by observing the times of vibration of a pendulum ball suspended alternately by two wires, whose difference in length was known.

A toise was set upright on a narrow horizontal plane firmly fixed to a perpendicular iron bar, and the contrivance by which the pendulums were suspended could be placed either on the horizontal plane, or on the top of the toise itself, so that the effective lengths of the wires differed in the two cases by an amount exactly equal to the length of the toise. The wires, which were of steel, were attached to a thin strip of brass which unwound itself over a small cylinder. The pendulum, thus suspended, described the curve called the evolute of the circle. At the lower end of the iron bar there was a micrometer screw, for measuring small differences in the height of the ball.

The system of observation was as follows. At the commencement of a series of coincidences with the longer pendulum, the thermometers attached to the toise were recorded, and the reading of the lower surface of the ball was taken with the micrometer screw; the pendulum was then set in motion, and after a sufficient number of coincidences had been observed, the readings of the ball and thermometers were again taken. Exactly the same process was then gone through with the shorter pendulum: then, from the times of vibration of the two pendulums, whose absolute lengths were unknown, but whose difference in length was accurately known, the length of the seconds' pendulum was easily computed.* There were a great many minute details to be attended to, all of which were carried out with the greatest ingenuity and nicety, and all conceivable sources of error were considered, and their effects computed and allowed for.

The coincidences were observed in a slightly different way from any preceding method. The pendulum was enclosed in a wooden case, faced with glass to keep out currents of air, as well as to preserve as constant a temperature as possible; the clock was placed about $8\frac{1}{2}$

* Let t_1 & l_1 be times of vibration and length of longer pendulum.

t_2 l_2 ,, ,, ,, shorter ,,

$l_1 - l_2$ = difference in length = a

L = length of seconds' pendulum.

Then $t_1^2 = \pi^2 \dfrac{l_1}{g}$, $t_2^2 = \pi^2 \dfrac{l_2}{g}$, $1 = \pi^2 \dfrac{L}{g}$

$$\therefore \frac{t_1^2}{t_2^2} = \frac{l_1}{l_2}, \quad \frac{t_1^2 - t_2^2}{t_1^2} = \frac{l_1 - l_2}{l_1} \text{ or } \frac{l_1}{t_1^2} = \frac{a}{t_1^2 - t_2^2}$$

Again $\dfrac{1}{t_1^2} = \dfrac{L}{l_1}$ or $L = \dfrac{l_1}{t_1^2} = \dfrac{a}{[illegible]}$

feet in front of the pendulum, and between the two, the object glass of a telescope was adjusted to form an image of the detached pendulum in the plane of the clock pendulum, to enable them both to be seen simultaneously through the observing telescope, which was set up at a distance of about 15 feet. On the wire of the detached pendulum was fixed a small brass cylinder, painted black and called the coincidence cylinder; it weighed something under 4 grains, and could be brought exactly opposite the scale for measuring the arc of vibration.

On this scale a black streak was painted, in the middle of which a space was left white, equal to the diameter of the coincidence cylinder, so that when the pendulum was at rest, the cylinder exactly covered it. Again, to the bottom of the clock pendulum a piece of blackened paper was attached, in which a hole had been cut of such a size that when both pendulums were at rest, it exactly coincided with the image of the white space on the black streak: hence when the pendulums were moving in coincidence, the coincidence cylinder was visible through the hole, and completely eclipsed the white space. Bessel's result was expressed in lines of the toise of Peru, the standard used in the measurement of the Peruvian arc.

In publishing these experiments, M. Bessel pointed out the true correction for buoyancy, which he had investigated by swinging in air two spheres of equal diameters, but of different densities, one being of brass and the other of ivory, suspended by a fine steel wire; and again by swinging the same brass sphere first in air and then in water. These experiments showed that the old formula for reducing observations in air to a vacuum gave too small a correction, and that it should be multiplied by a factor.

Mr. Francis Baily made a long series of experiments on the correction for buoyancy, which were published in the Philosophical Transactions for 1832. He used about 80 pendulums, all differing in form, weight, and mode of suspension. From these experiments he deduced factors for pendulums of almost every description that have ever been used, and computed also the weight of the air adhering to each, in other words deduced the *vibrating* specific* gravity of the

* "The vibrating specific gravity of a compound pendulum is *ordinarily* found "as follows; Let d', d'' d''' ...denote the distance of the centre of gravity of each "body respectively from the axis of suspension: w', w'', w''', ...the weight (in air) "of each body: s', s'', s''', ...the specific gravity of each body determined in the

pendulum. He concluded from all his results, that even if a pendulum is formed of materials having the same specific gravity, yet if it be not of an uniform shape throughout, each distinct portion must be made the subject of a separate computation, in order to determine the correct vibrating specific gravity of the whole body, since each part will be differently affected by the surrounding air.

The last extensive series of experiments were those taken in 1828-31 by Captain Henry Foster, who was sent out on a scientific mission by the Board of Admiralty. He took out with him four invariable pendulums of different metals, two of Captain Kater's pattern, and two of Baily's convertible pattern. These last consisted of a plain straight bar, 2 inches wide, $\frac{1}{2}$ inch thick, and 5 feet $2\frac{1}{2}$ inches long, having two knife edges 39.4 inches apart, but no heavy bob or sliding weights, as in Captain Kater's pattern; the synchronism was adjusted by filing away at one end of the bar. Baily's intention was, that the pendulum should either be used as two different invariable pendulums, or applied as a single convertible one for absolute determinations at any station. The objection to the form is, that both the knife edges must be exactly perpendicular to the bar, or error is entailed, as the bar is not flexible like Kater's. Captain Foster swung pendulums at all his stations, 14 in number, which were chiefly in the southern hemisphere. He made a set of observations at Mr. Browne's house before the voyage; on the return of the pendulums to England, they were again swung at the same place, but by Mr. Baily, Captain Foster having been most unfortunately drowned in the River Chagres, in February 1831, just as his mission was completed. His observations were reduced by Mr Baily, who obtained from them an ellipticity of $\frac{1}{289.5}$.

About this time the Russian government sent out an expedition under Captain Lütke, who used an invariable pendulum, formerly used by Captain Basil Hall. He swung it first at Greenwich, and afterwards at Ualan, in the Caroline islands, Guam, Bonin island (to the

"usual manner. Then will the required *vibrating* specific gravity of the pen-"dulum be

$$S = \frac{w' d' + w'' d'' + w''' d''' + \ldots}{\frac{w' d'}{s'} + \frac{w'' d''}{s''} + \frac{w''' d'''}{s'''} + \ldots}\text{"}$$

(*Philosophical Transactions*, 1832.)

south-east of Japan), at Sitka in Russian North America, at Petropaulowski, Valparaiso, St. Helena, and St. Petersburg. He deduced an ellipticity of $\frac{1}{267}$ from his observations.

Schumacher, the celebrated astronomer of Altona, conducted in 1829-30 a series of experiments with Bessel's apparatus, at the castle of Guldenstein, in order to determine the Danish standard, which was to be a certain fractional part of the length of the seconds' pendulum, at the level of the sea, in latitude 45.° In order to estimate the influence of the air, he used, instead of a ball, a hollow cylinder of platinum, made by Repsold, inside which a second solid cylinder, also of platinum, fitted perfectly true. The outer cylinder was closed by covers of the same diameter screwing on to it, which were both perforated; the clamp holding the wire was fastened on to the top, and into the bottom was screwed a point with which the contact was made in measuring the height of the cylinder by the micrometer screw.

The pendulum was swung under four different circumstances, viz. the long pendulum, with and without the inner cylinder, and the short pendulum, also with and without it; and as exactly the same surface was exposed to the air in each case, the influence of it could be computed, which was done by a formula deduced by Bessel. The reduction of the observations was made by Professor Peters. One novelty was introduced, viz. that of computing out the attraction of the ground on which the observations were taken. A square space having a side of 600 toises (1279 yards), in the middle of which the observatory was situated, was subdivided again into 36 squares of 100 toises (213 yards) a side; in each of these borings were made, and specimens of the earth removed and their specific gravities determined; as these were very nearly the same, a mean of the whole was taken. The height of the floor of the pendulum room was $34\frac{1}{2}$ toises (220.6 feet) above the mean sea level, and the attraction of this plateau of the earth's crust introduced a change in the length of the second's pendulum of 0.000215 English inches.

Carlini, whilst measuring the Piedmontese arc in 1821-23, took a series of pendulum experiments at the Hospice on Mount Cenis, with the view of determining the density of the earth. His pendulum was formed of a heavy sphere suspended by a wire, which was attached to

a kind of inverted stirrup ; in the part corresponding to the foot plate there was fixed a wheel with a sharp edge turning on its axis. This wheel was placed on a grooved plate and formed the knife edge for suspension ; the arrangements for observing were similar to Bessel's. Corresponding observations, though not with the same apparatus, were taken by Biot and Mathieu at Bordeaux. The result was a density of 4.95.

One more attempt to determine the density of the earth, by means of the pendulum, was made in 1854, by the Astronomer Royal, Professor Airy, at the Harton Colliery pit. Two invariable pendulums were set up in the same vertical line, one at the top, the other at the bottom of the pit ; and their coincidences with the pendulums of two clocks were simultaneously observed, the relative rates of the clocks being determined by a galvanic apparatus. After each series of coincidences the pendulums were interchanged. The distance between the upper and lower pendulums was 1256 feet ; a careful description of the intervening strata was prepared and specimens submitted to Professor W. H. Miller who determined their specific gravities. The acceleration of the seconds' pendulums below was 2.24 seconds per diem, and the resulting mean density of the earth was 6.565.

The best value of the earth's ellipticity as yet deduced from pendulum observations is undoubtedly that of Mr. Baily's. He combined all the observations taken with invariable pendulums, and after applying to them all corrections, obtained a mean ellipticity of $\frac{1}{285 \cdot 3}$. The latest value of the same, from geodetic observations, is Captain Clarke's R. E. which includes the new Russian arc and is $\frac{1}{294 \cdot 36}$. The ellipticity obtained from observations of precession and nutation is $\frac{1}{303 \cdot 3}$ (Airy's tracts).

The apparatus for the Indian experiments consists of two invariable pendulums on Kater's principle, a vacuum apparatus with air pump for exhausting, an astronomical clock by Shelton, a good battery of thermometers, and a transit instrument. Both pendulums have already done good service : one having been used by General Sabine in his extensive range of experiments, the other by Professor Airy in his Harton pit experiments ; they cannot be considered, however, to have retained their original length, as their knife edges have been reground. Each is composed of a bar of plate brass 1.6 inches wide and rather less

than an ⅛th of an inch thick; a strong cross piece of brass is rivetted and soldered to the top to hold the knife edge, which consists of a prism of very hard steel, passing through the bar and adjusted at right angles to its surface. The prism is equilateral in section, but the edge on which it vibrates is ground to an angle of about 120°; the length of the bar from knife edge to the extremity is about 5 feet 1½ inches. At 3′ 2¼″ from the knife edge, a flat circular bob, also of brass nicely turned and pierced in the direction of its diameter, is firmly soldered on; the part of the bar beneath the weight, called the tail-piece, which is about 17″ in length, is reduced to a breadth of 0.7 of an inch and is varnished black, in order to contrast better with the white disc on the clock pendulum, in the observation of the coincidences.

The knife edges rest on agate planes set in a solid brass frame, which is provided with three levelling screws. On the outer side of each plane are Y's, which are moveable in a vertical direction by means of an eccentric; the knife edges rest in them when the pendulum is not in use, and by their means the observer is enabled to lower the pendulum down gently so as to bear always on the same parts of the agate planes. Each pendulum has its own set of planes, and will give different results, if swung on any others.

It has been decided to swing the Indian pendulums in vacuo, in order to secure the following advantages. When the pendulum has been set in motion, it will vibrate for a whole day; its temperature will be more equable; it will not be disturbed by currents of air; and errors in the formula for the correction for buoyancy are unimportant. The vacuum apparatus consists of a cylinder of sheet copper about 1 foot in diameter and rather more than 5 feet long, with hemispherical caps, the upper one of glass and moveable, the lower one of sheet copper and soldered to the cylinder. The upper end of the cylinder carries a strong brass plate, to which are attached the frames containing the agate planes and a bar of the same metal and shape as the pendulums; placed side by side with a pendulum inside the apparatus, the bar and pendulum will be of the same temperature, and it is evident that thermometers attached to the former will give the required temperature of the latter. Two delicate thermometers are attached to the bar, their bulbs being sunk in the metal at points

equidistant from each other and the ends of the bar. The stem of the upper thermometer is inverted, and placed side by side with that of the lower thermometer, in order that they may both be viewed through a moderate sized glass plate let into the cylinder. In the lower part of the cylinder there are four other windows, two on the line of the pendulums, to enable their coincidences to be observed; the other two at right angles to these, to give additional light and enable the observer to ascertain whether the detached pendulum is vibrating truly without wabble. There are two scales fixed at right angles to each other, inside the cylinder, on a level with these windows, one of which is used for measuring the arc of vibration of the pendulum, and the other to measure the distance of the pendulum from the former scale, which is necessary to furnish the correction for parallax in the readings of the arc of vibration: it is useful also in placing the pendulum at a constant distance from the clock, which is found convenient in practice.

The upper 4″ of the cylinder is made of greater thickness than the rest, and at the top is a strong projecting flange which is intended to rest on a strong cast iron frame made in two pieces, so as to grip the cylinder round the thicker part just below the flange; the halves of the frame are then firmly bolted together with nuts and screws. The upper surface of the flange is ground perfectly true to receive a bell glass, the cap already mentioned, which is like the receiver of an ordinary air-pump. The eccentric for raising and lowering the pendulum on to the agate planes passes through a stuffing box in the upper part of the cylinder. Motion is imparted to the pendulums by means of a fork and crutch turned by a spindle which passes through another stuffing box.

The clock with which the vibrations are compared is firmly secured to a wall, and the vacuum apparatus is erected in front, at a distance of about 2 feet from it. The diaphragm for limiting the view of the disc is fitted inside the clock case.

The telescope, for observing the coincidences, is placed on a small masonry pier, at a distance of about 8 feet from the vacuum apparatus, and is mounted so as to slide laterally on a graduated horizontal bar; it has also a slight vertical motion. The thermometers and barometers are read from alongside of this pillar by means of a cathetometer, viz.

a telescope sliding up and down on a vertical rod. The object of this is to obviate the ill effects of any defect in the isolation of the apparatus, as well as the influence of the observer's person on the thermometers.

As the disc on the bob of the clock and the tail-piece of the detached pendulum are too far apart to be viewed simultaneously by the telescope, a lens is placed between them, so as to throw the image of the white disc upon the tail-piece of the pendulum. The vacuum cylinder and all its adjuncts, air-pump, &c. were made by Adie, and are the only new portions of the apparatus.

The method of operation is as follows. After setting up the clock, the vacuum apparatus is inserted in the iron frame and suspended either on wooden trestles or masonry piers; the frame is roughly levelled; the temperature bar is fixed in position; the agate planes are screwed on firmly to their bed plate, and are very carefully levelled by means of delicate spirit levels provided for the purpose. A pendulum is now inserted and let down upon its planes, but the clock must not yet be set in motion. The telescope is next set up on the prolongation of the line which passes through the two pendulums, when both are at rest. For this purpose it is moved laterally on its graduated support, until a very small portion of the paper disc, on the bob of the clock pendulum, is visible on one side of the tail-piece of the detached pendulum. The reading is noted, and the telescope is then moved in the opposite direction, until an equal portion of the disc is visible on the other side of the tail-piece; the reading is again noted and the telescope is set to the mean position. The pendulum is then removed, and the diaphragm in the clock case adjusted, until its cheeks are tangents to the disc. The pendulum may now be replaced, and nothing remains to be done but to exhaust the air out of the apparatus and to set the pendulum in motion.

The observations are made in exactly the same way as already described in the account of Captain Kater's apparatus; the times of the disappearance and reappearance are both noted, and the mean taken as the true time of coincidence. The arc of vibration is then determined by noting the reading of the arc, when it is cut by the same edge of the tail-piece on each side of the vertical line. The thermometers and barometer are read by means of the cathetometer. It is usual to

observe not every coincidence, but the first three consecutive coincidences, and than the 11th, 12th, 13th, then the 21st, 22nd, 23rd, and so on; after observing the first two or three, the times of the after coincidences can be easily computed with sufficient accuracy to intimate when the observer should be ready to note them.

It is intended to have observations made generally along the Great Arc at stations 2′′ apart in latitude, and at other points where it may be desirable to obtain data regarding local variations in the intensity of gravity.

The pendulum experiments in this country will afford an independent value of the ellipticity of the Indian arc. It is also hoped that they will throw some light on the existing discordances between the astronomical and geodetic latitudes of the Indian survey.

The amount of the deflections of the plumb line, due to the Himalayas and elevated table lands to the north of India, have been computed by Archdeacon Pratt for the different terminal stations of the Indian arcs; but these determinations are so much in excess of the results of the survey, that it is evident that the effects of the mountain attraction must be in a considerable degree compensated, either by a deficiency of density in the strata to the north, or by an excess of density in the strata to the south of the survey stations.

Now, the pendulum can undoubtedly be made the means of showing whether the compensation is to be attributed to either of these causes; for, whilst the effect of a distant range of mountains on the vibrations would be quite inappreciable, any local variation in the density of the underlying strata would show itself most unmistakably; so that by taking observations both at a normal station, and at a few points in its vicinity symmetrically situated around it, should there be any considerable excess or defect in the density of the strata to counteract the disturbance due to the mountain mass, the pendulum observations would not fail to point it out.*

* Professor Stokes remarks in his letter on these operations: "The pendu-"lum no doubt indicates only the vertical component of the disturbing force, "whereas it is the *horizontal component in the plane of the meridian* that affects "the measures of arcs; at any one station, of course, a horizontal disturbance "may exist without a vertical disturbance, and vice versâ; but in a *system* of "stations disturbances of the one kind must necessarily be accompanied by dis-"turbances of the other kind. Indeed, it is theoretically possible, from the ver-"tical disturbances, supposed to be known, *actually to calculate* the horizontal "diturbances, and that without assuming anything beyond the law of universal

The Indian operations will eventually be combined with those taken previously with similar instruments in other parts of the world, to deduce the ellipticity of the earth's mean figure. Both Sir John Herschel and Professor Stokes have remarked, in their letters on the proposed Indian operations, that almost all observations hitherto made have been taken at stations either on islands or coasts, so that a series along the centre of a continent is very much needed. A complete set of observations has been already taken at the Kew observatory by Mr. B. Loewy, with the Indian apparatus; and on the completion of the experiments in this country it will be returned to Kew, in order that final observations may be taken, to show whether the pendulums have undergone any change in the interim.

It is to be hoped, however, that so good an opportunity will not be lost of extending these observations to stations easily accessible from India, though not included within its limits. On this head Professor Miller's opinion may be quoted at length, "Much would be added to the value of the observations made at the stations of the Indian survey, if, before the pendulums were brought back to England, observations could to be made with them at some other points, especially points nearer to the equator, such, for instance, as the south coast of Ceylon, Singapore, or on the coast of Borneo. Another accessible point, interesting from being in a long line of depression, where a large gravitation might be expected, is Aden."

The intention of the Russian government, to have similar observations made along the Russian arc, has already been alluded to. If, after the return of the pendulums to England, they were to be swung at one of the Russian stations, it will be possible to combine the Russian with the Indian operations, and deduce a value of the earth's ellipticity from exclusively Continental observations, extending from cape Comorin to the northernmost part of Finmark.

"gravitation. Actually to carry this out, would probably require observations "to be made at stations more numerous than can be thought of, but the fact of "its possibility shows how severe a check pendulum observations are capable of "exercising on the results of geodetic observations."

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Notes of a tour made in 1863-64 *in the Tributary Mehals under the Commissioner of Chota-Nagpore, Bonai, Gangpore, Odeypore and Sirgooja.—By* Lt.-Col. T. Dalton.

[Received 2nd September, 1864.]

Bonai is a small hilly district lying very snugly isolated from all civilization, between Sarundah the wildest part of Singbhoom and the Tributary Mehals of Keonjhur, Bamra, and Gangpore. It is 58 miles in greatest length from east to west and 37 miles in greatest breadth from north to south, with an area of 1,297 square miles. It is for the most part a mass of uninhabited hills, only $\frac{1}{12}$th of the whole being under cultivation, but about its centre, on both banks of the Brahmini river, which bisects it, there is a beautiful valley containing the sites of upwards of twenty good, and for the most part coterminous villages, the houses well sheltered by very ancient mango and tamarind trees, with a due proportion of graceful palms. The tâl and date appear to grow very luxuriantly in the valley, and sugar-cane thrives there. Many of the villages lie close to the river and their luxuriant groves meet and form long undulating lines of high and well-wooded bank. On all sides, at the distance of a few miles, are hills, some nearly three thousand feet above the level of the valley, and thus a very pleasing and varied landscape is disclosed at every turn of the broad and rapid rock-broken stream.

The Brahmini river in its progress from Gangpore has forced its way through the barrier of hills separating the two districts, and enters the valley I am describing, after a course of eight miles through a beautiful glen, in a succession of rapids and loughs, the latter swarming with alligators. The shortest route from Gangpore to Bonai is by a rugged path through this pass; but is only practicable in the dry weather.

Bonaigurh, where the Rajah resides, is in the valley, occupying a bend of the river in latitude 28° 49′ N. and longitude 85° E., being 508 feet above the sea level. It has the river on three sides, and is surrounded by a mud wall and moat, within which are about 150 houses, including those of the chief, his court-house, and jail: the village altogether, inside and outside the gurh, contains about 300 houses, but nothing that can be called a bazar. The inhabitants are the Brahmins and other retainers of the Rajah; his own family, including most of the collateral branches, legitimate and illegitimate; people practising trades—workers in brass and pewter, potters, weavers, smiths; and people of low caste, Gonds, Pahans, Ghassees and Domes. Ooriah is the language spoken, and the costume and customs followed are those of the Orissa provinces. This includes a lavish use of saffron in their ablutions, hair neatly dressed with silver ornaments, and a general tidy appearance. They have good features and rather fair complexion. The young girls, till they attain the age of puberty, are very scantily dressed. The only garment usually worn by them is a "kopin"—a scarf, round the loins and between the legs. This is national and classical, as we find from the images of the oldest temples, that it was the favourite costume of the Hindu goddesses, who thus enjoyed the full play of their limbs. The young people of both sexes are fond of adorning themselves with wreaths of bright yellow flowers.

There are 217 inhabited villages in Bonai, and from the number of houses returned by the topographical survey recently completed, the population may be estimated at fifteen thousand six hundred souls. About one half of the agricultural population is of the "Bhooya" caste or race. They are doubtless the earliest settlers, and it was from their hands that the ancestor of the present Rajpoot Rajah first obtained his insignia as chief. The Bamra and Gangpore Rajahs are reported to have in the same manner derived their chieftainships from

the Bhooya aborigines, and when a succession to the Raj takes place in any of these districts, the acknowledged head of tho Bhooya clan goes through a ceremony of making over to the new chief the country and the people. The person who claims this prerogative in Bonai is titularly called "Sawunt." He holds, at the very trifling quit-rent of Rs. 18 a year, twelve villages with their hamlets, and claims to be the hereditary Dewan of Bonai, but the chief neither employs nor acknowledges him as such. There are two other similar tenures with the titles of 'Dhunput' and 'Mahapater,' and subordinate to them are certain privileged heads of villages called Naiks. Under the Sawunt, Dhunput, or Mahapater, the subordinate officers of the Bhooya *militia*, —all the able-bodied males of the tribe are bound at the requisition of the chief or of the Government, to turn out for service fully armed and equipped. There are no military tenures in the hands of people of any other caste. The Bhooyas thus have great power in the little state. Nor is it only in consequence of their being thus organized as a military body; I find they have also charge of the oldest temples and shrines, and discharge the duties of Levites to the exclusion of Brahmins. Yet the temples are dedicated to Hindu gods. Whatever their origin may be, the Bhooyas are now completely Hinduized. They have no peculiar language or customs of their own. In Bonai and the southern parts of Gangpore they speak Ooriah. In the northern parts of Gangpore and Jushpore, Hindi. They are a dark-complexioned race, with rather high cheek-bones, but with nothing else in feature or form to distinguish them as of extraneous origin. According to their own traditions, they were once a great people in Eastern India and had a king of their own, but were dispersed by invasion from the west. They are now found in all the districts between Cuttack and Behar, but they are most numerous in this and the adjoining estates, and here may be found the most civilized and respectable and the most primitive of the family. While in the lowlands, they dwell in villages, clothe themselves decently, and otherwise follow the customs, adopt the manners, and, I may add, the intriguing nature of the more civilized Brahminical races. In the hills of Bonai they are found as naked, as simple, as truthful and unsophisticated as the wildest of the Cole tribes. There are a great number of Bhooyas in the Singbhoom district, and it is said that they were driven out of the west portion of it, by the advance and spread of the Lurka Coles.

The Bhooyas call themselves 'children of the wind' 'Pawun buns,' this would establish their affinity to the Apes, as Hunooman is called "Pawun-ka-poote" the son of the wind.*

The Bonai hills shelter some thousands of the race commonly called Coles, who all represent themselves as having at some period emigrated from Singbhoom or Chota-Nagpore. They have not benefited by the change. Their brethren on the Chota-Nagpore plateau and in the plains of Singbhoom are better off and better looking. The emigrants must be the most unimprovable of the race, who, finding that the old country is becoming too civilized for them, fly from the clearances they have made, hide themselves in the hill forests, and relapse into the condition of savages.

Amongst the races of Bonai yet to be noticed, are the Kolitas, a very enterprising and respectable class of cultivators, that are found in these regions, Sumbulpore, and strange to say, Assam.

A very large proportion of the purely Hindu part of the Assamese population are Kolitas, and in accounting for the different races that are found in that province, the antecedents of the Kolitas have always been a difficulty. They have none of the peculiarities of the Indo-Chinese stock. They are considered, in Assam, as of very pure caste, next in dignity to Kaists, and are on this account much in request amongst the higher classes as house servants. Another difficulty in Assam was to account for what was called the Bhooya dynasty, of which traces are found all through the valley, and it is recorded in their history, that the north bank of the Brahmapootra above Bishnath was known as the country of the Barra Bhooya, long subsequent to the subjugation of the districts of the southern bank by the Ahoms. It appears to me, that there is a strong reason for supposing that the purely Hindu portion of the Assamese Sudra population was originally from this part of India. There is, in idiom especially, a strong resemblance between the Assamese and Ooriah languages, and though the Ooriah written character did not take root in Assam, this may be owing to all the priestly families having been introduced from Bengal.†

* They very probably formed a division in Rama's army, hence their adoption of Hunooman's pedigree, and their veneration for "Mahabir."

† In a paper in the Asiatic Society's Journal for June 1848, the Assam Kolitas are described by Col. Hannay as having the high and regular features of the Hindu, and many of them with the grey eye that is frequently found amongst the Rajputs of Western India.

The appearance of the Bonai Kolitas reminded me very much of the Assam Kolitas, and I may mention that Ram Chunder, the seventh Avatar, is the favourite object of worship with both.

Of the mineral and other resources of Bonai, I have not much to say. Iron is produced, but the hills are for the most part quite unexplored, and their riches, if they possess any, unknown. The population, with so much room for expansion, does not increase. There are 83 deserted village sites, and what are now small hamlets appear to have been at one time large villages. The cause is not apparent, as the people of the more civilized class are well to do and content, and rent is very low, and as in all the Tributary Mehals, fixed. It is Rs. 2-8 for a hull of 17 khundees. Nevertheless the chief tells me he is obliged to grant all manner of extraneous indulgences to his ryots to induce them to remain.

Wild beasts are very numerous, and in their ravages lies one great difficulty that villages bordering on or in the jungles have to contend against—the ryots complain not of loss of life but of the destruction of crops. They say they have to raise grain for the beasts of the forest as well as for their own families. On this account very little cotton is cultivated, though the soil is well adapted for it.

The store of Sâl timber in Bonai is immense, but the isolated and almost inaccessible position of the forests will prevent their being utilized for years to come, except for the resin, to obtain which, so many noble trees are girdled and killed. Together with the Sâl, are found vast quantities of the Asan tree on which the tusser silk-worm feeds, and a considerable quantity of the wild tusser is exported from Bonai, but it is not much cultivated as the mass of the population look upon it as an impure or unorthodox occupation, and none but people of the lowest castes, the Domes, Ghassees, Pahans and Gonds practice it. (The Gonds are out of their element in Bonai and are thus classed.)

We meet with no Rajpoot or Khettree family except that of the chief. Nothing can be more absurd than the tradition handed down to account for this possession of power by one Khettree family over an alien population. The Nagbungsi family of Chota-Nagpore admit that they are sprung from a child found by and brought up in a "Moondah"* family, and that this child was made chief of the whole

* *Kole.*

Moondah race. It is I think highly probable that the chiefs of Bonai and Gangpore were originally Bhooyas who becoming leaders of their people and Rajahs, and allying themselves by marriages with other Rajahs were gradually admitted into the fraternity of Rajpoots or Khettrees. It may be said indeed of both of them, that the intermarriage with families of better certified Khettree descent has not yet obliterated their Bhooya lineaments, for they bear a very remarkable likeness to that race in feature.

Gangpore.

This is a very extensive estate lying between Chota-Nagpore, Jushpore, Oodeypore, Sumbulpore, Bamra, Bonai and Singbhoom. It is kidney-shaped. Its greatest length from east to west is about 97 miles, and in breadth from north to south it varies from 15 to 50 miles. The topographical survey of the estate is not yet complete and its area cannot therefore be computed with accuracy, but I estimate it at double the size of Bonai or about 3000 square miles. Of this area not more than a tenth is under cultivation.

The Sunkh and Koel rivers from the plateau of Chota-Nagpore, unite near Gurjun in Gangpore and form the Brahmini. The Eeb, another river of some magnitude, flows through Gangpore south on its way to the Mahanuddee. The ordinary level of Gangpore is about 700 feet above the sea; the highest hill yet noted by the topographical surveyor is 2,240, not much above the general level of the Chota-Nagpore plateau. The descent, however, from the plateau to the ordinary level of Gangpore is gradual, and there is a tolerable road. As in Bonai, the majority of the population are Bhooya, and they were no doubt the first settlers. All the zemindars under the Rajah are of that race, and hold their estates as fiefs at low fixed rates and terms of service. Consequently the Rajah is under the necessity of adopting a conciliatory policy towards some of them at least. There are generally one or two in opposition, but fortunately for the Lord Paramount, the great vassals are too jealous of each other readily to combine. The largest estate is held by the vassal who bears the title of Mahapater. It borders on Singhbhoom, extends to the Brahmini river and comprises 100 villages for which the Mahapater pays only Rs. 200. This part of Gangpore was at one time more densely populated than it is at present, but all the more peaceably disposed of the old inhabitants

including, it is said, several colonies of Brahmins, were slaughtered or driven out of the country by the Lurka Coles. To the south, another great vassal, under the title of Gurhoutea, holds the Hemzeer estate, consisting of 84 villages, and an unlimited run of hill and forest. Gungadhur the Gurhoutea, boasts that he can travel twenty-four miles in a direct line over his own ground without seeing a human habitation, all through hill and forest, which, united to enormous tracts of hill and forest of Raigurh and Sumbulpore, forms perhaps the most extensive uninhabited region in all India. The third of these vassals has his estate on the north-west of Gangpore and holds the passes into the country from Jushpore and Chota-Nagpore. This estate is in advance of the passes, and looks as if it had been filched from Jushpore, to which from the geographical features it ought to belong.

The chief is of the 'Seekur' family and claims connectionship with the Rajah of Pachete. His ancestor the first Rajah of Gangpore, was, we are told, invited by the Bhooyas to take charge of their country; from which, it is said, they had just expelled a Rajpoot family called the "Kaiserbuns;" but as I stated above, I think it more probable that the ruling family are descended from the original Bhooya chiefs. The traditions, assigning to them a nobler birth, are founded on the supposition that the Rajpoots or Cshetryas were the only class qualified to rule, that where there was no one of this class over a nation or a people, "the Guddee" was vacant, and a Cshetrya had only to step in and take it. The Cshetryas must have wandered about like knights-errant of old, in search of these vacant Guddees, as we do not find in the country any descendants of the followers whom they must have had, if they came in other fashion to oust the native chiefs and seize the country.

It was admitted to me that until these Tributary Mehals came under British rule, a human sacrifice was offered every third year before the shrine of Kali at Suadeeh, where the present Rajah resides. The same triennial offering was made in Bonai and Bamra, Bhooya priests officiating at all three shrines. This fact appears to me to be confirmatory of the theory that the Hindus derived from the aboriginal races the practice of human sacrifices.

In the above named districts, the practice of widows going "suttee" was also generally followed in the family of the chiefs and in Brah-

min families, up to a recent date; many of the grandmothers of the present generation of chiefs and Brahmins having so distinguished themselves. One man was pointed out to me as having lost his mother by the rite of suttee. *He* would not say 'lost;' he no doubt regards her as canonized by the act.

A rather romantic story of a suttee that occurred some fifty years ago in Gangpore is related.

A Brahmin took a dislike to a girl he had just married, and turned her out of doors, a wedded maid. She took refuge with her parents who were poor, and who soon after died, leaving her destitute; then she wandered from village to village subsisting on alms and leading a wretched widowed life. Her husband married a second time, and sons and daughters were born to him and grew up about him, and in the fullness of years he died. His second wife had preceded him, so his corpse was placed alone on the funeral pile, and the torch was about to be applied to it, when a poor emaciated and meanly clad female stepped forward, and as the first, the faithful and only surviving wife of the deceased, claimed the right of suttee. Her request was complied with. Bathed, anointed, clothed, and adorned with flowers like a bride, she ascended the pile and clinging to the corpse of the husband who had so cruelly discarded her, and for the first time in her life pressing her lips to his, the flames arose and their ashes were mingled together!

There is no doubt still a strong sentiment in favour of suttee in the Tributary Mehals, and States under native government. Its prohibition has not been long enforced in the eastern parts of Rewa. Not long ago, in that territory, on the death of a Brahmin, his widow, notwithstanding the prohibition, was so vehement in her desire to join her husband on the pyre, that her relatives as the only method of restraining her, *locked her* up. When the ceremony was over they proceeded to release her, but found that her spirit too had fled. She had attained her object, as my informant declared, by a special interposition of Providence in her behalf.

Proceeding north-west from Nugra and the banks of the Brahmini river, you enter the Nuagurh division of Gangpore and come to Lainggurh, near the confluence of several streams, which was once the capital and promises to be so again, as the present Rajah is just now

building there. It is very prettily situated, and the gurh on a little hill in the centre of the valley has a commanding position, but I fear it is not a healthy site, from the number of enlarged spleens and cases of skin-disease I observed amongst the people. There are many fine old village sites in Nuagurh, now occupied by impoverished squatters, mostly Oraons from Chota-Nagpore.

The old inhabitants have died off or removed to more civilized and securer regions further south. The shabby huts of the squatters huddled together under the shade of the grand old trees, the monuments of the more civilized race that preceded them, look as much out of place as mud cabins in a street of palaces. The Rajah and other zemindars give these new settlers, when they first come, three years of absolute immunity from demands of every kind. In the fourth year they are called on to pay a light assessment. It is difficult to describe on what principle it is imposed, but in old settled villages of Oraons it does not amount, including rent and contribution, to more than Rs. 1-8 per house or family. The soil in this part of Gangpore appears very fertile, and there is still available much of the slightly swampy, rich looking land, that gives the best crops of rice. I find "Sirosha" now in flower, growing in great luxuriance. It is sold here at one maund for the rupee.

The Coles are evidently a good pioneering race, fond of new clearings and the luxuriant and easily raised crops of the virgin soil, and have constitutions that thrive on malaria; so it is perhaps in the best interest of humanity and cause of civilization that they be kept moving by continued Aryan propulsion. Ever armed with bow, arrows and pole-axe, they are prepared to do battle with the beasts of the forest, holding even the king of the forest, the "Bun Rajah," that is the tiger, in little fear. Mixed up with them are numbers of the Kherria tribe, who are as yet a mystery to me, and I will say nothing more about them till I learn more. I am assured that they have no affinity with either Moondahs or Oraons, *i. e.* with those who are generally called Coles.

Borgaon, near the Mahabeer hill on the borders of Bamra, is the largest village Gangpore possesses on this side. It contains 160 houses—20 of Brahmins, 20 of 'Telis,' oil-pressers, 22 of various Hindu Ooriah castes, and the remainder Oraons and Kherriahs. The two

latter coming in contact with Brahmins, have at once succumbed and become their farm labourers. It appears to make little difference in the condition of Oraon emigrants, whether they are farm servants or farmers on their own account: they have the same wretched huts, scanty apparel, and generally uncared-for appearance, as if they had in despair given up all ideas of rendering themselves attractive; but the wonder is that they remain in this dependent position, when they can get land on such easy terms and become farmers themselves.

The village pays direct to the Rajah a *rent* of Rs. 34, magun or contribution Rs. 34 l, and 64 maunds of rice. The price of rice is from one maund to two maunds for the rupee. On births, deaths and marriages in the Rajah's family, the villagers are called on for additional contributions, and when that family, as it is just now, is a large one, the extra charge comes to from Rs. 30 to 40 a year. The total demand is therefore about Rs. 160 a year, and from the extent of land under cultivation, I do not think this would amount to more than 3 annas a beegah on the cultivated area. It is evidently a very old village site, surrounded by extensive groves of mangoes, and with several tanks of very insalubrious water overgrown with water lillies. Hills are seen on all sides, but the most remarkable feature in the landscape is the great Mahabeer hill; a mass of rock tilted up, and shewing towards Borgaon, an uneven wall of disrupted ends, forming a cliff of fantastic outline, nearly 2000 feet high.

The tutelary deity of this hill is a favourite object of worship with the Bhooyas, and is more or less revered by all the country. The top of the hill or rock being difficult of access, Mahabeer has studied the convenience of his votaries, and entered an appearance down below in the form of a stone, in a sacred grove or 'Surna' at the foot of the hill. The idea of a 'Surna' is pretty and poetical. It is or ought to be a fragment of the primitive forest left when the first clearance was made, as a refuge for the sylvan deities whom the clearing might have disturbed. The best villages and most thriving portion of the population in Gangpore are found on both banks of the Eeb river, as we approach the boundaries of Sumbulpore. Here the very industrious and respectable looking caste called Agureahs are first met with. They are found in Gangpore, Sumbulpore, Raegurh, Raipore and Ruttenpore. They number about 5000 in the three first places named.

According to their tradition, they are called Agureahs from having, ages ago, come from Agra.

They were a proud Cshettrya or Khettree family, a stiff-necked generation, and refusing, when making an obeisance, to bow their heads, the Rajah lowered some of them summarily by cutting them off. They therefore left Agra and wandered south through Central India till they came to Sumbulpore, and eventually settled in these regions. Acquiring lands, and determining to devote themselves entirely to the tilling of the soil, they divested themselves of their "paitas" making them over to the Brahmins, and no longer styling themselves or being styled Khettrees, they became known as Aguriahs.

They *bury their* dead, and for this departure from the usual custom of Hindus, they can assign no specific cause, but that they gave up the practice of incremation when they resigned their pretensions to be esteemed Khettrees. They nevertheless now profess to be Vishnoovis, divided into two denominations, 'Ramanundyas' and 'Kubeer punthees.' The Vishnoovi doctrines they have probably taken up, since their migration to tracts bordering on Orissa and approximating the great fane of Juggernath. They say they gave up the worship of Kali when they resigned their 'paitas' and took to the plough. It is probable that they were Boodhists, obliged to leave the Gangetic provinces for refusing to conform to Brahminism.

Their physique decidedly supports the tradition of their Khettri extraction: they are distinguished amongst the dark, coarse-featured aborigines of this country, as a tall, fair, well-made and handsome race, resembling the Rajpoots in every thing but swagger. *That* went with the 'paitas,' as a farewell offering to Kali. The women, who are not very jealously secluded, have good features and figures, and a neat and cleanly appearance.

The latter are subjected to no field labour, their sole business being to look after the domestic arrangements, to gin cotton and to spin. They do not weave. Their spun thread is made over to the weavers, who are paid in kind for their labour. Their villages, laid out in streets, are comparatively well kept, and their own houses in these villages substantial, clean, and comfortable. Munguspore, near the Sumbulpore boundary, is, I think, the largest. It contains 200 houses, those of the Aguriahs occupying the centre of the village, surrounded by huts

of Coles and others of the primitive races, whose services they have secured as their farm labourers, and who are not allowed to hold lands, but are paid for their labour at the rate of three seers of dhan per diem, and a modicum of clothing doled out annually.

The soil in this part of Gangpore is exceedingly rich, producing magnificent crops of sirosha, sugar-cane, and tobacco, besides the staple rice. The plants of the country tobacco grown by the Aguriahs are the finest I ever saw, and they grow more cotton than they require for their own use, though they do not stint themselves in raiment. I am certain the soil and climate is well suited for the finer kinds of cotton.

Proceeding north up the Eeb from this, the Arabia Felix of Gangpore, we came again upon untidy Bhooya villages, and their patches of cultivation, separated by miles of the monotonous Sâl forests, and there is no change in the features of the country or the population, till we come to the estate of Bhugwan Manjee, which, as above mentioned, does not appear as if it belonged to Gangpore, as it is separated by a range of hills, and approached by a very narrow and difficult pass. We are still amongst Bhooyas, but here they speak Hindi instead of Ooriah, and the peculiarities of Ooriah costume and decoration are rarely met with.

Jushpore.

The small state of Jushpore, though specially mentioned as a cession to the British in the agreement taken from Appa Sahib, after his defeat at Setahbuldee in 1818, has hitherto found no place in any published map. In the very latest issued from the Surveyor General's office, a few scattered villages of Jushpore are inserted as if contained within the boundaries of Sirgoojah, but the name of the estate is not given, and the chief town, where the Rajah now lives, is not down. It is singular how old the information must be, from which some names have been inserted on the maps of the unsurveyed parts of India.

Konkale appears in large letters in about the centre of the tract which should be called Jushpore. It is now an insignificant hamlet, but there is the trace of a fort, where resided an ancestor of the present Rajah. The present capital, Jugdispore, is about two miles to the north and west of it.

Jushpore is bounded on the north by Burway of Chota-Nagpore; south by Gangpore and Oodeypore; east by Chota-Nagpore; and west

by Sirgoojah. It is about 50 miles in length from north to south, and 30 in greatest breadth from east to west, and may comprise about 1000 square miles. It contains upwards of 200 villages, exclusive of the hamlets or detached huts of migratory hill savages; the population is about 30,000, and the total income of the Rajah from all sources may be estimated at about Rs. 6000. With this moderate income he maintains a very becoming state, and so rules as to be greatly beloved by all his people.

Jushpore is about equally divided into highlands and lowlands, 'Oopur Ghât' and 'Heth Ghât.' The highlands consist of a magnificent plateau, a continuation of the great tableland of Chota-Nagpore, averaging upwards of 2000 feet above the level of the sea, and fringed by hills, rising in places 1000 feet higher. The lowlands lie in steppes descending towards the south, broken by low ranges of hills isolated bluffs, and masses of granite, sometimes semi-globular in form, and without vegetation, bare and round as an old man's bald pate, and hence the most conspicuous of them is called the 'Boora.'

The Eeb river has its sources in the Jushpore highlands, and grows so rapidly into a respectable stream, that when it reaches the brink of the plateau, it bounds into the lowlands with a roar that is heard for miles. It is, shortly after, joined by another stream, the Maini, which also rises in the Jushpore heights. There is a story that, years ago, an invisible spirit in a visible light canoe ascended the Eeb, waterfall and all, to its source, and there the boat is still waiting for the spirit's return. I *did not* see it.

It is also called the 'Heera' river, as diamonds are found in its bed, and it is probably the source of the diamond stores of the Maha Nuddee, as I understand that none have been found above the confluence of the two streams. It is auriferous, and from time immemorial its sands and deposits have been explored by hereditary gold-washers, called "Jhorahs." These gold-washers do not, however, confine their operations to the bed of the river. They find it more profitable to penetrate the soil some distance from its banks, and on both sides you find tracts honey-combed with shafts, sunk by successive generations of gold seekers.

These shafts are from 10 to 30 feet in depth, and three in diameter. The Jhorahs excavate till they cut through the upper

stratum of vegetable mould and the red soil beneath it, and come to a layer of pebbles and fragments, chiefly of quartz, forming a dirty damp gravel; this they remove and wash. I have watched their operations close along the banks of the river, and at some miles distant from the stream, and the process and result was much the same in both places. Near the river, five pits or shafts had been recently sunk by as many families of Jhorahs, for they work in families, women and children assisting. They had one washing trough, called a 'dooin,' to each family, and the washing commenced in my presence. The stuff selected is either of a dirty drab or of a reddish colour, with occasional small white spots, little balls of particles of decomposed felspar, adhering together from moisture, and drying into powder. The Jhorahs regard these white spots as the surest indication that the gravel contains gold. The stratum of gravel which they were working on this occasion was not more than a foot in depth. It rests on decomposed granite, which crumbles when taken in the hand, and the gold-washers assured me that this contained no gold, but I insisted on having some of it washed, and found their statement not strictly correct. It contains gold, but is less rich in the mineral than the gravel above. When the gravel immediately under the shaft is all removed, they scoop out from the sides all round, as far as they dare venture to penetrate laterally, and in this way sometimes connect the shafts, but they take no precautions, and sometimes, going too far, have to be dug out, not always alive! There appear to have been several accidents of the kind, but with all this danger and labour, the pursuit does not return sufficient to support them, and they are farmers as well as gold-washers.

They are greedy and reckless in taking advances, trusting much, no doubt, to the facilities their remote situation gives them, of evading payment, and some of them are enormously in debt. One man was pointed out to me as owing Rs. 1000! He grinned as the sum was mentioned, as if exulting over his victim. The greed for gold and the gambling nature of the pursuit is surely a great corrupter of human nature, for in the midst of a population generally remarkable for honesty, truthfulness and simplicity, these gold-washers are mendacious and unscrupulous rogues.

Some years ago, a trader came amongst them whilst they were at

work, accompanied by his wife, hoping to obtain some return for the advances he had made. He dunned and worried them, and to get rid of his importunity, they knocked him on the head and popped him into one of the 30 feet shafts, where he was told to seek gold for himself! The unfortunate woman was similarly disposed of. The crime was, however, brought home to the delinquents, who were all transported.

The yield of these pits in gold is of course very uncertain. The out-turn obtained in my presence from the five pits, in about four hours, would not have given to the individuals employed; more than half an anna a head, but they admitted that they sometimes obtained as much as half a tolah of gold from one 'dooin' in a day, and this would give about Rs. 2 a head to the hands employed, and make up for many blank days. From their mode of washing, there must be great waste. I observed it is only very palpable particles of gold that are retained. The grains are irregularly shaped, with sharp angles, and do not appear to have undergone any disturbing process since they were evolved from their original matrix. There is no indication of flattening or rolling out.

The northern portion of Jushpore, bordering on Burway and Sirgoojah, is a wild mountainous region called Khooria, inhabited chiefly by *Korewahs;* some, utterly savage and almost nomadic; others, somewhat more civilized, living in villages; but all invariably armed with bow and arrows and a battle-axe.

In 1818 when Sirgoojah and Jushpore were ceded to the British Government by Appa Sahib, the chief of Khooria, himself a Korewah, and claiming to be hereditary Dewan of Jushpore, was in rebellion against his Rajah; and for several years, by savage raids at the head of his Korewahs, both on Sirgoojah and Jushpore, gave much trouble. In one of these expeditions, his son Muniar Singh was captured and detained as a hostage by the British authorities till the death of the old chief, when a reconciliation was effected between the Rajah and Muniar Singh, who was restored to his possessions and hereditary office. The policy adopted on the occasion has proved very successful: the dewans Korewahs have ever since conducted themselves peaceably.

Having expressed a wish to see some of the wild hill Korewahs, the present zemindar of Khooria, a nephew of Muniar Singh's, ap-

peared in camp with forty warriors of the tribe. Their costume was nothing in particular, except that they had very shaggy heads of hair, into which their store of spare arrows were stuck by the barbs. They each carried in one hand a very powerful bow and two or three arrows, and in the other the gleaming long edged battle-axe of the country. The arrows are carefully made with flat bright heads of iron, 9 inches long and 2½ in breadth, with long barbs, the edges and points all carefully sharpened. These are attached to light reeds, the other ends of which are neatly spirally feathered.

The men were mostly short of stature but with well knit muscular frames, springy and energetic in action, better looking and of lighter complexion than the Oraons of the plateau. There was no remarkable protuberance of the maxillary processes nor lowness of forehead. Those who were old enough had beards and moustaches. They evinced no timidity, but immediately on seeing me, gruffly vociferated that they had had nothing to eat all day, and they wanted immediately, rations of rice, dâl, oil, salt, tobacco and *pig*, and expected as they had come so far to see me, that they were each to be presented with a *cap*, a *coat* and a *waist cloth*.

I placed a small earthen pot on a peg, and offered it as a mark to those amongst them who wished to shew their skill in archery. In great excitement, all eagerly volunteered, bows were instantly strung, and though they did not once hit the small target, they all planted their arrows close to it, and a man in the same position would not have escaped. I tried them afterwards at a tree at 40 yards, and almost every arrow told. Their bows are very powerful, and arrow after arrow was delivered with a force and rapidity that made one feel a very profound respect for this, *our* once national weapon. In bush warfare it is more formidable than the matchlock, and I do not doubt that the Korewahs could render a hostile entry into their country, a difficult and dangerous task.

There is every point of resemblance between them and the wilder section of the Lurka Coles, and so little do the languages of the two tribes differ, that my slight acquaintance with that of the Coles, enabled me to understand what the Korewahs, on first appearing, were demanding; and a Cole chaprassee of mine kept up a conversation with them.

It is almost unnecessary to seek for further proofs of affinity, but they

are to be found in the identity of many of their customs. Their sacrifices in cases of sickness, their songs, their dances, their mode of disposing of the dead—all these shew them to be of kin to the 'Ho' or Lurka of Singbhoom, the Moondahs of Chota-Nagpore, and to the Sonthals. It is not possible to trace the similitude through all the relations of life. The Singbhoom Coles live in large communities and have an organization unattainable by the hill Korewahs, who prefer to dwell apart. Except on great occasions, when there is a 'gathering of the clan,' the Korewah has only his own family to think of and associate with. The head of the family is chief and priest—the god to whom he sacrifices, the spirit of his father.

The Korewahs are found also in the wildest parts of Sirgoojah, and in the ranges of hills between Sirgoojah and Palamow. Many of them have abandoned their free mountain life, and have formed settlements on the skirts of hills, near villages; and where this is the case they appear to be losing their own language and peculiar habits, and becoming Hinduized.

The Hill Korewahs live in wretched little detached huts, in the midst of the patch of hill forest they have partially cleared and are then cultivating, shifting every three or four years as the ground becomes exhausted. They cultivate very little rice. Their crops consist of pulses, millet, pumpkins, cucumbers,* melons, sweet potatoes, and yams. They also grow and prepare arrow-root, and there is a wild arrow-root which they use and sell. The grain they store for winter use is secured in small parcels of the leaves of a plant called 'muhoolain,' sown together by fibres of the same, and these parcels they bury. The grain thus preserved remains for years unimpaired. They have no prejudices in regard to animal food, and they drink freely of an intoxicating beverage prepared by themselves from millet. They are as devoted to songs and dances as the Moondahs and Sonthals, and have the same steps and melodies. They bury or burn their dead, whichever they find most convenient, but the practice of marking the spot where the body or ashes are deposited, is common to both.

The Khooria Korewahs resort in large numbers to an annual fair held at Muhree on the borders of Sirgoojah, and give in barter for salt

* They have a gigantic cucumber about a foot and a half in length and ten inches in diameter!

and other necessaries, wax, arrow-root, resin, gums, honey and stick lac, and excellent iron smelted by themselves. The Korewah iron, roughly fashioned as battle-axes, is greatly prized by the inhabitants of all the neighbouring States.

Whilst conversing with the Rajah about these savages, he mentioned to me that there existed a tribe called Birhores, whom he accused of a sort of interfraternal anthropophagy, of feeding literally on their blood relations.

They are alluded to by the late Col. Ouseley, in a paper that appeared in the Journal of the Society for January 1848, but he relates the story, as of the Korewahs, calling them inhabitants of Mynepât in Sirgoojah. The Korewahs repudiate all affinity with the Birhores, nor could I hear of either Korewahs or Birhores on the Mynepât: the latter are found in some of the wildest parts of Chota-Nagpore and Jushpore, but they are of rare occurrence. With much trouble some were caught and brought to me. They were wretched looking objects, but had more the appearance of the most abject of one of those degraded castes of Hindu, the domes or pariahs, to whom most flesh is food, than of hill people. Assuring me that they had themselves given up the practice, they admitted that their fathers were in the habit of disposing of their dead in the manner indicated; *viz.* by feasting on the bodies, but they declared they never shortened life to provide such feasts, and shrunk with horror at the idea of any bodies but those of their own blood relations being served up at them! The Rajah said he had heard that, when a Birhore thought his end was approaching, he himself invited his kindred to feast on his body. The Birhores brought to me did not acknowledge this, but they spoke on the subject with a degree of reticence that made me think it might be true. I told the Rajah to enquire particularly about it, and gave out that if the horrid rite was still practised, it must be discontinued. But, query,—'would not Saturday reviewers regard my order as an injudicious interference with a time-honoured custom, on a point that natives were so peculiarly tenacious of——the *disposal of their dead?*'

The Birhores speak a jargon of Hindi, which I found intelligible; and have no other language.

Nine-tenths of the population of the remaining portion of the Jushpore highlands are "Coles." Chiefly Oraons, there are very few Moon-

dals amongst them; the Jushpore Oraons are the ugliest of the race, and appear to me utterly destitute of all ambition to rise into respectability of appearance. With foreheads "villainous low," flat noses and projecting maxillaries, they approach the negro in physiognomy, much closer than do their brethren in Chota-Nagpore.

Jushpore produces an excellent iron, much prized for making weapons and implements of husbandry. Amongst its exports may be included about ten thousand maunds of cotton.

The lowland villages of Jushpore have a sprinkling of the tribes from all the surrounding districts. Of the Orissa type are "Makoors" from Keonjhur, the most thriving people in these parts, well dressed, and occupying good houses. They have great herds of cattle, like the Aheers and Gwallas. Then there are a few of the Gangpore Bhooyas, intermingled with a good many Khairwars from Palamow, (of which caste is the Rajah,) and Gours or Gonds from the south and west, and as we approach Oodeypore, we come for the first time on the *Kaurs.*

The Kaurs form a considerable proportion of the population of Oodeypore, Sirgoojah, Korea, Chang Bhukar, and Korbah of Chutteesgurh, and there is this point of interest in them, that they claim to be the descendants of the "Kooroos" who fought the Pándavas, who, when defeated and driven from the scenes of the war, found a safe retreat in these mountainous and densely-wooded regions. In appearance they more resemble the aborigines than the Hindu tribes. They are, in fact, next to the Jushpore Oraons, the ugliest race I have seen in the course of my tour: dark and coarse-featured, broad noses, wide mouths and thick lips. They resemble the Khairwars of Palamow, especially that ill-favoured section of them called Bhogtahs, in features, but in nothing else, as the Kaurs are an exceedingly industrious and thriving people. Their houses are unusually neat and commodious, built like bungalows, with verandahs on two or more sides. Of these there is one to each married member of the family, who, however, meet and eat together in the largest, belonging to the head. The houses are placed so as to form a small court-yard, which is kept scrupulously clean. The Kaurs do not strictly conform to Hinduism: they rear and eat fowls, and have no veneration for Brahmins. The "Nâu," the village barber, whom they sometimes call Thakoor, is their priest, and officiates as such at all marriages and other ceremonies. The

combination of priestly functions and operations with the easy shaving line, is singular; but it arises from the fact that the great ceremonial law of the Kaurs is all comprised in the act of shaving. At births, deaths and marriages, the parties immediately interested, and all connected with them, are clean shaven all round. In regard to the disposal of the dead by this tribe, they tell me that they bury those that die unmarried, while the bodies of married folk are burnt in orthodox Hindu fashion! I wonder if matrimonial interests are advanced by this invidious custom. The tonsure of the males is peculiar; the hair is allowed to grow long on the crown of the head and collected in a knot, but the forehead is shaven to the knot, and there is a shaven ring round it as if to facilitate the operation of scalping; the back of the head is also shaven, but over the ears and temples the hair is worn long.

They worship Shiva under the denomination of Mahadeva, and Parvati as Gouree, and they have a festival in the year for each, at which they dance and sing, men and women. In some villages there is a Baiga who offers sacrifices at these festivals; but this Baiga is not a Kaur. He belongs to one of the aboriginal tribes, and it is a remarkable feature in the religious ceremonies of the people of the Tributary Mehals, that the aborigines should have a monopoly of such offices. The new settlers dread the malignancy of the local spirits, and to appease them, naturally rely on the aborigines, who have longest known them. The zemindar of Korbah in Chutteesgurh is a Kaur, and as far as I can learn is the most influential person of their caste existing: there was a Kaur zemindar in Sirgoojah formerly, called Kumol Singh, but he rebelled and came to grief.

Most of the "Khalsa" villages in Oodeypore are held in farm by 'Kaurs' and two-thirds of the population of these villages are Kaurs. With one exception all the permanent service tenures of Oodeypore are in the hands of Gours, and the people in those estates are for the most part Gours. We find therefore, that the Gours have, in Oodeypore, a position similar to that held by the Bhooyas in Bamra, Gangpore and Bonai, and the right to the office of Dewan and to instal a new Rajah, claimed in those districts by certain Bhooyas, is in Oodeypore claimed by one of the Gour zemindars, Bhowany Singh of Kourajah. Thus we find the Gours or Gonds, who in Bonai were

classed amongst the most degraded of the people, (and in Gangpore not held in much higher estimation,) holding a high position in Oodeypore.

I have insensibly glided into Oodeypore. In no published map are the boundaries of that district defined. It has to the north the great tableland of the Mynepât, as a massive barrier between it and Sirgoojah, to the west Korbah of Chutteesgurh or the Belaspore district, to the south Raigurh, and to the east Gangpore and Jushpore. It is about 64 miles in length by 40 in breadth, and contains about 1800 square miles. There are 220 villages. The population may be roughly estimated at 25,000. The only river of consequence is the Mand, an affluent of the Mahanuddee. It rises near Girsa in Sirgoojah, and receives the streams that flow south from the Mynepât. Near Rabcope, which, though not much of a place, we may call the chief town, it has cut its way through a great mass of sandstone rock, and now flows without obstruction through a narrow pass with perpendicular or rather overhanging cliffs, on the highest portion of which the former Rajahs of Oodeypore, like Barons of the Rhine, had their castle. The site was occupied by the leader of the Oodeypore insurgents in 1857-58, and had he not abandoned his position on the approach of a force sent against him, he might have given us much trouble, as the rock is or might easily be made as inaccessible from the land as from the river side. The river has generally a deep cut channel, flows in alternate rapids and pools, and is not navigable in any part of its course. The country north of Rabcobe rises in steppes to the base of the Mynepât, but the surface is everywhere undulated by masses of sandstone rock, forming hills, dividing and enriching the culturable lands, as the rocks have many springs, from which fertilizing streams are ever flowing over the terraced plains. But with all these advantages the country is sparsely populated, the villages small and 'far between,' and there appears little prospect of improvement, as the districts all round are in much the same condition.

There is at present but one weekly market held in Oodeypore, at Dukree, 24 miles due south of Rabcobe. This is attended by people from Raigurh, Chutteesgurh, Sucktee, &c. The chief exports are lac, cotton, resin, oil seeds, rice, wild arrow-root, iron, and a small quantity of gold.

The production of the precious metal is restricted by the limited number of gold-washers. There are now only six families of that profession on the estate. The same cause may be assigned for the limited production of iron, as there are not more than ten families of smelters in all Oodeypore. I saw the gold-washers at work in pits similar to those I inspected at Jushpore. The deposit sought and the method of working it is the same in both mehals, but the deposit in Jushpore is supposed to be the richer of the two. In Oodeypore, the gold-washers produced, as the result of a day's labour, only 3 grains of gold to each "Dooin" or trough, but I am satisfied from what I saw of the quantity of gold exhibited at each washing-out of the trough, that they must have obtained very much more than they thought proper to produce. The Rajah was with me; he wishes to obtain a monopoly of the gold trade; and it did not suit them that he should see a better yield.

The export of 'lac' from Oodeypore is said to amount to about 2000 maunds annually. I have not been able to gain any information in regard to other produce, but the heavy expense of carriage and consequent low prices offered, are very discouraging to the producers. Amongst the mineral resources not yet utilized, is coal; seams have been observed at Baisi south-west of Rabcobe, and other places. Limestone is found under the Mynepât.

SIRGOOJAH.

I entered Sirgoojah from the north-west corner of Oodeypore, ascending the Metringa Ghât and passing along a ridge, a cyclopean wall of sandstone that actually divides the sources of the Rehur, an affluent of the Soane, from some feeders of the Mand, an affluent of the Maha Nuddee; and near the same point the boundaries of Sirgoojah, Oodeypore and Chutteesgurh meet. Clear of the Ghât, which is very steep and difficult, I find myself at the western extremity of the great Mynepât, which rises majestically from the plain in a succession of bold headlands and promontories, as our own proud islands rise from the sea; and as the eye follows what so much resembles a long coast line, the mind is filled with the idea that the ocean must once have rolled where the Sâl trees now wave, and this is strengthened when we turn to the isolated bluffs having all the features of the mainland, from which they appear to have been cut off, rising abruptly like islands

from the sea, not less than 2000 feet above the plain, or appearing in the distance, from the parallel markings on the face of the rock, like huge casemated batteries protecting the coast.

The country teems with architectural remains of a race who appear to have left no other trace of their existence. On the banks of the Rehur, in great heaps of carved stones, shafts, bases, capitals, friezes, architraves, lie the ruins of numerous temples of a very ancient type. (The Rajah's cousin, Lall Mohessuree Persad Singh, on whose estate they lie, is very irreverently using them up in the construction of a sporting lodge). The fragments appear to have been put together as children build with wooden bricks, all in parallel courses, with nothing but their weight and adaptation of the parts to keep them in their position; and thus their overthrow, which from the studied mutilation of all the idols could not have been accidental, was easily effected. There is no indication of any kind of cement or of iron bindings having been used in the structures.

Amongst the isolated hills mentioned above, the most conspicuous is that of Rama or Ramgurh, which rises from the plain about 8 miles west of the Mynepât. From one distant aspect, the upper portion of the hill alone appearing above the Sâl forest, its resemblance to a monster fort with a cupola roof is very striking, so regular is its form and so abruptly precipitous are its sides. Approaching it, however, it is seen to have a variety of outworks of its own.

The ascent commences from the north side, proceeding up and along narrow ridges of one of these outworks, till you reach nearly to the base of the great rock itself, and there are the ruins of a very ancient stone gateway. The lintel now lying on the ground is adorned with the image of 'Gunesh' as the Janitor. Inside, between the gate and the rock, there is a level path both east and west. Proceeding westward, you come to an ample space of level ground affording room for a small encampment, in deepest shade, under a perfectly perpendicular portion of the huge rock, reminding one of the description of 'Sinai,' the mount that could be touched with the hand but must not. The approach to this spot from the gateway was originally protected by a stone breastwork now fallen, and the importance of protecting it is obvious, as here the rock sends out a jet of perfectly pure water, just such as one could suppose to have issued by Divine command at the

touch of Moses. The temperature of the water was, strange to say, much higher than that of the air, but cooled in a *sorai* it was delicious. A broad seam of coal is here seen underlying the sandstone. It burns well, but I say no more about it, as the Sirgoojah coal from this vicinity has been fully reported on by my predecessor Col. Ouseley. To continue the ascent of the hill, you repass the gate, and proceed by an easy path three parts round the hill to its southern face, and then as best you can *up*, by an exceedingly difficult zig-zag path, sometimes a mere ledge cut out in the rock. Just at the commencement of the difficult part of the ascent, you pass a large boulder of sandstone with nothing to distinguish it externally from many others that are lying about, but which has been hollowed into a chamber of sufficient capacity to allow of a man sitting in it at his ease, and with an aperture just large enough for a slender man to creep in by. The opening is not seen from the path; so that an unconscious pilgrim might find himself exhorted by a voice from the bowels of a rock in a manner truly awe-striking. Crowning the most difficult part of the ascent, so perched that you cannot obtain a good view of it without looking right up to the sky, from a position that makes it unpleasant to throw your head back to the necessary angle, is a second gateway, which is in better preservation, and is the best executed and most beautiful architectural antiquity of the entire region. Though its origin is equally unknown, it is unquestionably a more modern work than the other gateways and temples on the hill. It belongs to that description of Hindu architecture which bears most resemblance to the Saracenic. Instead of a flat lintel over the gate, we have an arch formed of three voussoirs of stone. The soffit of this arch is cut into a wavy scroll, terminating on the abutments, in heads of some animal not clearly discernible. There is an exterior and interior arch of this description, springing from fluted pilasters, and the space of about three feet between them is covered in by another loftier arch similarly formed. Entering, you find yourself in a small court, at the bottom of a flight of steps. A projection of the rock has been scarped to form this resting place, and from it a most extensive view south and west is obtained. The steps are to the right as you enter, to the left there is a projection with stone breastwork used as a look-out. Opposite the entrance, there was a covered colonnade, but this has fallen in.

In the thickness of the gateway wall, a niche four feet in depth and about eight feet in height and breadth, is divided by a column still in position, shewing how the fragments of the columns of the ruined colonnade should be restored. The shaft and base are octagonal and the bracket-like projections of the capital are crouching human figures, so placed, that head, arms, hands and back all appear to support the abacus. There is one well executed figure in this enclosure, of a man kneeling on a coiled cobra, and with snake heads peering over each shoulder.

A flight of 48 cut stone steps leads from this resting place to another mass of ruins which appear to have been a temple and gateway combined. There is here an image of Durga with 20 arms, another with eight, and a large figure of Hunooman, all more or less mutilated. We are now on the ridge forming the top of the hill. Bare as are the sides of the rock, there must be here a great depth of soil, as it supports a variety of large forest trees and shrubs, which are growing luxuriantly. On the highest part of the ridge and about the centre of the hill, is the temple, which contained no doubt the principal object of worship. It consisted of a small fane, the inner crust of which, constructed of parallel courses of roughly cut stone, is still standing, with a detached portico on columns. It is small and insignificant, but no doubt immensely old; it is impossible to say to what idol or object of worship the temple was originally dedicated; at present, on the old "argha" or stand, there is a group of Vishnu with his wives, but the group does not fit the pedestal, is of more elaborate workmanship than the figures that are lying about, and whilst all the old figures are mutilated, this one is perfect. I conclude that it was placed in the temple after its partial destruction, and the mutilation of the original images.

I found the air on the hill keen and invigorating. There is space for several houses on the saddle back; and as it is an independent isolated mountain, it commands an extensive view, shewing that all this part of Sirgoojah, which the maps make out to be a mass of hills, from the foot of the Mynepât, as far as the eye from this elevation can penetrate westward, is, thus seen, a plain slightly undulating, but on the whole well adapted for the *Railroad*, which, I am confident, will some day be made through it, connecting, by the most direct route, Calcutta, Central India and Bombay.

The tableland called the Mynepât is 50 miles in length by 40 in breadth, with an elevation of 3,700 feet above the sea level. Its soil, like that on the Ramgurh hill, is deep and rich, and it possesses numerous springs and streams. It abounds in game; gaur, buffalo, tigers, leopards, and deer, and some of the streams are large enough to give the angler gentler sport. The day must surely come for the fructification of all these natural advantages, and the tract now occupied by a few herdsmen and savages, may become the head-quarters of a division, or the seat of a Government.

Not far from the summit of the Ramgurh hill, an attempt has been made to construct a tank, but it probably was not a success, and it is now nearly filled up with light vegetable mould, of not less than three feet in depth and quite dry. In another direction, a descent of a few hundred feet brings you to a pool of good water percolating a seam of white calcareous clay. A party defending themselves on the rock could not be cut off from this supply, as it is perfectly inaccessible from below, but it would not be adequate to the supply of a large party, and the next nearest source is the spring near the first gateway.

But the great curiosity of the Ramgurh hill has yet to be described. Two of the spurs of the great rock, themselves rocky and precipitous, forming buttresses on the northern face, instead of gently blending with the plain like others, have their bases truncated, and then united by a vast natural wall of sandstone rock, 150 yards thick and 100 to 150 in height. A semi-circular or rather horse shoe shaped nook is thus formed, which, from the height and precipitous nature of the sandstone rock enclosing it, would be almost inaccessible, had not nature provided an entrance by a natural tunnel through the subtending wall. This is called the "Hathphor." The waters collected from springs in the nook form a little stream that flows out through the tunnel. At its mouth it is about twenty feet in height by thirty in breadth, but at the inner extremity of its course of 150 yards, it is not more than eight feet by twelve. A man on horseback could ride through it. The sand of the stream in the tunnel was impressed with old and recent foot-prints of a whole family of tigers, who had taken up their abode in this pleasant and secure retreat, but we did not find them at home. The horse shoe embraces an acre or two of ground, well wooded and undulating, so that a considerable body of men could

conveniently encamp there. In the face of the great rock opposite the entrance, two large caves have been excavated by human labour, the largest of the two, sufficient to afford accommodation for forty or fifty people. The entrance, about 30 feet wide, opens into a gallery of double that length, with recesses at the extremities, intended for more private apartments, probably for females. The excavation is made so as to leave a platform of stone, extending through its whole length, and also in the recesses, for the occupants of the cave to sit and sleep on. The floor is some fifteen feet above the ground, but is accessible by steps cut in the rock. In both caves I found inscriptions carved on the rock in ancient 'Pali' character, and I made the best transcript of them I could: this is now in the hands of Babu Rajendra Lal Mitra, and it will, I trust, throw some light on the history of the retreat.

Since writing the above, I have seen Col. Ouseley's brief notice of the Ramgurh hill in the Asiatic Society's Journal No. CLXXXVI. for January 1848. He does not appear to have observed the inscriptions, and I do not recollect having seen in the caves any of the stone figures that he noticed there. They may have been since removed. Col. Ouseley calls these antiquities cave temples, but there is nothing now to indicate that they were intended as places of worship.

There are many other interesting collections of ruins in Sirgoojah. Those to the west, in the Pal Pergunnahs, noticed by Col. Ouseley, I have not seen, but he found there a stone with an inscription on it, which I think must be in the Society's museum. On the banks of the Kunhur river in Tuppah Chulgalee, there is a large collection of temple ruins. Three distinct heaps of fragments were at my request opened out, till the foundations of three large temples dedicated to Shiva and Durga were disclosed. The object of worship in the largest, was a huge Lingum, five feet in length, which we found divorced from its appropriate "Yoni" as if it had been blown up. The latter was smashed into several pieces by the destroying force, whatever it may have been, and the numerous sadly maimed gods and goddesses that were found in the debris, are further memorials of the barbarous zeal of some uncompromising iconoclast. I observed a Shib's bull in good preservation, as large as life, a well executed figure of 'Parvati' three feet high, and a grand, colossal, four armed figure with one foot resting on a broad-edged axe, not unlike what is still the national

weapon of the tributary mehals. Close to the temples there is a stone-faced tank.

Six miles to the west of the above ruins at Sirnidee there is another small temple which appears to have been overlooked by the destroyer. The dome over the fane is still standing, and part of the vestibule, the latter a pyramidal roof supported on columns. The stones forming the lintels and uprights of the entrance to the fane are elaborately carved with minute representations of all the principal Hindu gods. Shiva and his wife on Nandi occupying the place of honour in the centre of the lintel.

The Ruksale Rajpoot family who now hold Sirgoojah, have no tradition regarding the antiquities I am describing, but they tell me that under the Mahratta rule, their ancestors often availed themselves of the retreat of the Hathphor to save their property from pillage and their women from dishonour.

The ruins of an ancient castle of the Ruksale Rajahs of Sirgoojah are to be seen on a hill near Bisrampore, and this appears to be the Sirgoojah, marked as the chief town on the map, shewing again the antiquity of the information from which the maps of these unsurveyed tracts had been filled in.

According to the tradition preserved in the family, the first Ruksale was called into existence by a 'Muni' or sage, to destroy a demon that troubled the holy man in his devotions. The hero thus created was the ancestor of the lovely Rukmini carried off by Krishna. In about Samvat 251, a lineal descendant of Rukmini's brother, Rukman, entered Sirgoojah and fought with and killed the Rajah of the place called 'Balind,' and became Rajah in his room. The present Maharajah Inderjeet Singh has a family tree to shew that he is the 111th in descent from the conqueror of Balind ! but I have been told there is a popular tradition assigning to the family a local origin, and considering there are no Ruksales in any other country, it is not unlikely that it is the most truthful of the two. If so, it is probable that the family are derived from the same stock as the 'Gours,' the most influential and numerous of the races now inhabiting Sirgoojah.

In A. D. 1758, a Mahratta army in progress to the Ganges overran the district of Sirgoojah, and the chief was compelled to acknowledge himself a tributary of the Berar government, but

beyond a fine imposed at the time, and engagements taken for the security of the roads from Mirzapore, Benares and Gya to the capital of Nagpore, no proofs of submission were exacted.

In the year 1792, Sirgoojah first engaged the attention of the British Government, in consequence of its Rajah Ajeet Singh having invaded and taken possession of Burway, a Pergunnah of Chota-Nagpore. At the requisition of the Governor-General, the Rajah of Berar interposed; but ineffectually, as about this time, on the death of Ajeet Singh, his third brother Lall Sungram Singh usurped the chieftainship, murdered Ajeet Singh's widow, and not only retained possession of Burway, but assisted a rebellion in Palamow against the British Government. This led to an expedition into Sirgoojah under Col. Jones by order of Marquis Wellesley, which resulted in the restoration of Burway to Chota-Nagpore, and Sirgoojah itself became a dependency of the British empire by treaty with Appa Sahib in 1818.

Sirgoojah has not been surveyed, and it is therefore impossible to give its area with any degree of accuracy. It is about 90 miles from east to west and 80 from north to south; is divided into 26 tuppahs and contains 1197 villages, and according to a return of houses made some years ago, a population of 1,30,000, one hundred and thirty thousand souls. About one-sixth of the whole are of the Gour tribe: the Khairwars, Kawrs, Kisan Rajwars, Korewahs and Coles number from 5000 to 7000 each: there are about 2000 Bhooyas, and about as many of the hill tribe found in greater numbers further west, called Boyars: the remainder of the population are for the most part Sudras. The ruling race, Rajpoots, number only 505 souls, and there are only 369 Brahmins.

Of the Gours, I have already observed that they are the same as the Gonds of the south. Of this there can be no doubt, as we find amongst the Gours of Oodeypore and Sirgoojah, blood relations of the Gonds down south; and they intermarry. It is only a different way of pronouncing the name of the tribe. They have always I believe been considered as amongst the aboriginal races of India, but in Sirgoojah and Oodeypore they are completely Hinduised, retaining neither the language nor any other characteristic of their own race.

The Kaurs and Korewahs have already been disposed of; the Coles must have a chapter to themselves; the characteristics of

the Rajwars and Kisans I have not yet had an opportunity of studying, and shall conclude with a few words about the Khairwars. They are found in many parts of this province but are most numerous and have been longest resident in Palamow. They are said to have migrated from the hills west of Rhotas; there is a place there, called Kyra, supposed to be named after them, and they are found about the Kymoor hills. The Rajah of Turki in that vicinity is a Khairwar. In this division several of our great men are said to be of Khairwar extraction, but they are all now undergoing that process of being refined into Rajpoots which I have described as likely to have occurred in other families, by intermarriage with Rajpoot maidens. They have to pay very high for the honour, but by giving large dowries with their daughters, they sometimes obtain for them also the distinction of Rajpoot alliances.

The two races appear to blend well; a handsomer and more energetic stock is the result; so the aspiring families I allude to, have gained something by their outlay in marriages, as the ordinary or pure Khairwars are generally a dark, ill-favoured race, with coarse features and of lazy unimprovable habits.

The people called Bhogtahs are a Khairwar tribe. There was a small clan of them in Palamow, who long defied the power of the British Government. They lived on a narrow plateau, with the Sirgoojah mountains behind them, and a range of hills with difficult passes in front of them; and with the cattle and property of their neighbours, they did very much as they pleased; and as they had wonderfully contrived retreats amongst the hills and rocks for themselves and their plunder, they defied all efforts to capture them. At last the wild country they occupied was given to them at a nominal rent, on condition of their living honest and peaceful lives. This kept them quiet for many years, but when the mutinies broke out in 1857, the two chiefs, Lilumber and Pitumber, headed an insurrection in Palamow and came to unmitigated grief. One was hanged and the other was transported for life and died in the Andamans.

The actual income of the Rajah of Sirgoojah from all sources is not more than Rs. 30,000 a year: the estates held by members of his family are worth in addition about Rs. 23,000, and other vassals hold estates worth annually about Rs. 20,000. A fixity of tenure is the

predominating feature in the revenue system of all the Tributary Mehals, and will no doubt be found to prevail in all parts of Hindustan where ancient landmarks have not been swept away by the tide of conquest. In these mehals, the great mass of the cultivators are the descendants of those who first occupied and tilled the soil, and to them, (says Malcolm in his Central India,) according to the most revered texts of the sacred writers, the soil in the first instance belongs; and where a monarchy or chieftainship is by some process eliminated, the peasant proprietor contributes for the support of the sovereign a moderate share of the produce of his land. This accounts for the lowness of rates of rents that prevail in these districts. The actual rent does not exceed 2 annas a beegah in Sirgoojah, and this is unchangeable. It probably represents the proportion of the produce first assigned to the chief, and both the cultivating classes and heads of villages in this province are exceedingly tenacious of their right to pay no more than one fixed rate of rent. The hereditary village headman pays no more on this account, and collects no more than the old fixed rate, but it does not now suffice for the requirements of the chief, and as noticed before in treating of Gangpore, a practice has arisen of giving as an ordinary contribution, a sum equal to the amount paid as rent, whilst extraordinary contributions are often exacted, and demands made for unpaid labour, which must greatly hamper the productive industry of the cultivators. In Sirgoojah I asked the Rájah and zemindars if all these irregular demands could not be done away with and a fair fixed rent taken in lieu. They expressed their willingness to abide by any arrangement of the kind that I could make, but referred me to the rent-payers and village headmen. *They*, with one consent, refused to acquiesce in any enhancement of rent.

Description of a supposed new Genus of the Gadidæ, Arakan.—*By Lieut.-Col.* S. R. Tickell, *Bengal Staff.* Plate I.

[Author's date, October, 1862.] [Received 8th June, 1864.]

Order. Malacopterygii subbrachiati.

Family. Gadidæ.

Genus. Asthenurus (mihi).

(ασθενὴς feeble and Ουρὰ Tail).

Body rounded—very little compressed—head small, muzzle short, mouth wide with a single row of minute teeth in each jaw, and a band across the anteal part of the palate. Scales of a medium size. No lateral line visible. Fins; two dorsals and two anals, joined by intermediate detached rays, which are partially membraned. The anterior dorsal and anal, quadruple the height of their posterior fellows. Ventrals jugular and filiform. Caudal bilobed and very small. Brancheostegous rays 7.

Asthenurus atripinnis. Tickell.

Specimen $5\frac{3}{8}''$ long. The largest of 4 or 5 observed, Akyab harbour. Arakan. October 15th, 1862.

Structure. See above for Genus. Body lengthened in the portion of the tail behind the 1st dorsal. Head small; snout short and blunt. Gill plates smooth and smooth-edged, their divisions not very distinct: but suboperculum large: scales medium-sized, semitransparent and deciduous. Along the back, from occiput to 1st D, a mesial groove, with a ridge along each side for the whole length of the fish to caudal. A deeper groove along mesial belly, in which the ventrals can lie encased. Intermaxillary long and narrow, and set with a row of minute pointed teeth jammed close together. Mandibles with a similar row, smaller still. Rest of mouth smooth. Tongue short, round, tied down to floor of mouth. Scales round at free edge, concentrically furrowed; about 67 from gill cover to base of C and 14 tiers. Air bladder large. Its shape and that of the intestines could not be ascertained, as the specimen examined had been a long time in spirits.

Fins. 1st D 20, detached rays 15—2nd D 20.—P, 21.—V 5.—A 20, detached rays 12—2nd A 26.—C 6-13-6.

1st D and 1st A have their 5th and 6th rays as long as the greatest depth of the body, the fins decreasing rapidly to the first and last rays. The 2nd D and A are much shorter rayed and close to C, and the space between them and their preceding fins is occupied by a row of short rays each with a basal membrane. Pectoral, small, broad, and pointed. C very small, and bilobed, the lower lobe blunter and shorter than the upper. Ventral, 3 first rays filiform, the 2nd reaching to the space between the two anals; 1st and 3rd a little shorter; 4th and 5th ordinary and membranous.

*Colour.** Pale ochreous grey, or horn colour, blackish along back, from minute dots powdered along edges of scales. Snout and head, red carneous. Iris, greenish silver. Fins black, with whitish bases, except Vs which are fleshy white. A rectangular patch of black above gill plates. Gill plates nacreous.

The specimen here figured is the largest of 4 or 5 obtained in the fish market of Akyab. The fish is not described by Cantor in his ichthyological catalogue of the Straits, and Cuvier and Valenciennes' great work, which is incomplete, does not include the Malacopterygii Subbrachiati. None of the Gadidæ (Cod family) have as yet been noticed in India, and the present subject is one of peculiar interest on that account: that is, if my allocation of it should prove correct, of which I think there can be little doubt, on an examination of the structure of the fish. In the synopsis of Cuvier's Regne Animal there is no genus amongst the Gadidæ which resembles it: but it may rank next to Phycis (Artedi.)

It does not appear uncommon. In October 1862 I procured four or five specimens from the estuary of the Koladyn at Akyab, and from Kyoukphyoo. Two of these I do myself the pleasure of forwarding to the Museum of the Asiatic Society. The alcohol in which they are preserved, has very little affected their natural colour.

* Fresh specimen.

"*On the degree of uncertainty which Local Attraction, if not allowed for, occasions in the Map of a Country, and in the Mean Figure of the Earth as determined by Geodesy; a Method of obtaining the Mean Figure free from ambiguity by a comparison of the Anglo-Gallic, Russian, and Indian Arcs; and Speculations on the Constitution of the Earth's Crust.*"—*By* ARCHDEACON PRATT.

[Received 4th August, 1864.]

To the Secretary of the Asiatic Society.

SIR,—I beg to forward to you a copy of a Paper lately printed in the Proceedings of the Royal Society (No. 64) on the topics notified at the head of this letter. Two years ago you accepted from me a "Series of Papers on Mountain and other Local Attraction in India," and published in your Journal a memorandum, regarding the effect of local attraction upon the operations of the Great Trigonometrical Survey of this country. The present Paper is not confined to India; but appertains to the globe in general. But as the results of the Indian Survey occupy an important position in the calculations, you may deem it to be not irrelevant to the objects of your Journal to publish some account of it.

The state in which the question of local attraction was left in my former communications to the Royal Society was this:—That in India the deviation of instruments of observation from the true vertical caused by the Mountains and by the Ocean is very great, far greater than had ever been supposed; that this deviation might be much increased or diminished by the effect of variations of density in the solid crust of the earth, but that of the amount of this we have no means of judging, as we are entirely ignorant of the constitution of the crust: and that the effect of local attraction on the Map of India constructed from the Survey would fortunately disappear as far as regards the relative position of places laid down, but that the precise position of the Map on the terrestrial spheroid could not be discovered, as it would depend upon the unknown total resultant local attraction arising from all causes at the station from which the Survey operations commence.

M. Otto Struve has lately called attention to similarly important deflections caused by local attraction in Russia—and especially to a remarkable difference of deflection at two stations near Moscow, only about eighteen miles apart, which is attributed to an invisible unknown cause in the strata below.

It has become, therefore, an important inquiry:—What degree of uncertainty does Local Attraction, if not allowed for, introduce into the two problems of geodesy, viz. (1) obtaining correct Maps of any country, and (2) determining the Mean Figure of the Earth.

These matters are discussed in the present Paper; and I would here observe, that the paper is complete in itself, and does not require a study of the previous communications.

2. With regard to the construction of Maps from Survey operations I show, as before in India, that no map in any other part of the world will be affected except in the way already stated, if the length of every measured arc of latitude is not greater than twelve degrees and a half, and of every measured arc of longitude not greater than fifteen. Now in point of fact, however long the great arcs (such as the Anglo-Gallic, the Russian, and the Indian) may be, they are always broken up into much smaller portions, so as to bring them very far within the above-mentioned limits. Hence the maps constructed from geodetic operations will always be relatively correct in themselves; but the precise position of the map on the terrestrial spheroid will be unknown by the amount of the unknown deflection of the plumb-line in latitude and longitude at the place which fixes the map.

In India the effect of the Himalaya Mountains and the Ocean, taken alone, would throw out the map by nearly half a mile. And, as already stated, there is no way of discovering with certainty how much this is increased or diminished by the effect of variations of density in the crust. If, however, the calculations which I give in the third section of this Paper are accepted, they show that the effect of variations in the density of the crust below almost entirely counteracts that of the mountains and ocean at Damargida in latitude 18° 3′ 15″, and the displacement of the map is almost insensible if fixed by that station. If fixed by the observed latitude of any other station, the map will be out of its place by the local

deflection of the plumb-line at that station. This, in the Indian Great Arc, will not exceed (supposing my reasoning as described below is accepted) one-thirteenth of a mile at any of the stations where the latitude has been observed. It appears also from these calculations, that, except in places evidently situated in most disadvantageous positions, the local attraction is rarely of any considerable amount.

3. In the second section of the Paper I proceed to ascertain the degree of uncertainty introduced, by our ignorance of the amount of local attraction, into the great problem of the Mean Figure of the Earth.

Bessel was the inventor of the method now in use for solving this problem. His method enables us to bring all the arcs which have been measured in any part of the world to bear simultaneously upon the solution. He made use of arcs measured in eight parts of the earth's surface; called the Anglo-Gallic, Russian, Indian II, (or Great Arc), Indian I, Prussian, Peruvian, Hanoverian, and Danish Arcs, the first three of which are very long. For each of these arcs he made use of an algebraical symbol to represent the unknown error of the precise position of the arc on the meridian. In his method he treats these eight quantities as independent variables; which is tantamount to ignoring local attraction altogether. The calculations, therefore, of the Mean Figure of the Earth hitherto made have left this most important element out of consideration. To remedy this has been my object. By a change, I venture to call it a correction, of Bessel's method I have succeeded in obtaining formulæ for the semiaxes and ellipticity of the Mean Figure, which involve expressions for the unknown local deflections of the plumb-line at the standard or reference-stations of the several arcs.

If a and b represent the semiaxes and e the ellipticity, the following are the results arrived at :—

$$a = 20928627 + 1057{\cdot}8t_1 + 342{\cdot}9t_2 + 152{\cdot}3t_3 + 27{\cdot}3t_4 + 93{\cdot}6t_5 + 8{\cdot}8t_6 + 63{\cdot}7t_7 + 62{\cdot}9t_8 \text{ feet.}$$

$$b = 20849309 - 3762{\cdot}6t_1 - 334{\cdot}3t_2 - 661{\cdot}3t_3 - 101{\cdot}5t_4 - 372{\cdot}6t_5 - 14{\cdot}0t_6 - 249{\cdot}3t_7 - 249{\cdot}1t_8 \text{ feet.}$$

From these we may easily deduce the ellipticity

$$e = \frac{1}{263 \cdot 9} \{ 1 + 0 \cdot 0608 t_1 + 0 \cdot 0085 t_2 + 0 \cdot 0103 t_3 + 0 \cdot 0016 t_4 + 0 \cdot 0059 t_5 + 0 \cdot 0003 t_6 + 0 \cdot 0039 t_7 + 0 \cdot 001639 t_8 \}.$$

where t_1 t_2 ... t_8 are the eight unknown deviations of the plumb-line from the true vertical at the standard stations of the eight arcs arising from local attraction.

These formulæ for the semiaxes and ellipticity of the mean figure of the earth show us, that the effect of local attraction upon the final numerical results may be very considerable: for example, a deflection of the plumb-line of only 5″ at the standard station (St. Agnes) of the Anglo-Gallic arc would introduce a correction of about one mile to the length of the semi-major-axis, and more than three miles to the semi-minor-axis. If the deflection at the standard station (Damargida) of the Indian Great Arc be what the mountains and ocean make it (without allowing any compensating effect from variations in density in the crust below, which no doubt exist, but which are altogether unknown) viz. about 17″·24, the semiaxes will be subject to a correction, arising from this cause alone, of half a mile and two miles. This is sufficient to show how great a degree of uncertainty local attraction, if not allowed for, introduces into the determination of the mean figure. As long as we have no means of ascertaining the amount of local attraction at the several standard-stations of the arcs employed in the calculation, this uncertainty regarding the mean figure, as determined by geodesy, must remain. The effect of our ignorance in this case is far more serious than that already noticed in mapping a country with minute precision.

4. The third section of the Paper is occupied in devising means for removing this ambiguity. Although it has been necessary to *assume* one step in the argument, I think that the sequel shows that a very high degree of probability exists that the process is a correct one.

Each of the three great arcs—the Anglo-Gallic, the Russian, and the Indian—is divided into a number of subordinate arcs. I therefore take each of these three great arcs and apply the method described in the last section to find the semiaxes of the ellipse which best represents that arc. The expressions for the semiaxes involve one unknown quantity, viz. the amount of deflection at the standard station of the arc. In this way I obtain the semiaxes of three ellipses,

involving three unknown quantities. The *assumption* which I then make is, that the Mean Figure of the Earth is a spheroid; that is, that these three ellipses are all the same. The effect of this is to give me four equations of condition, involving the three unknown quantities. These I solve by the method of least squares. The result is that the unknown deflections all come out very small; and the semiaxes of the three ellipses come out remarkably near each other in value. The first part of this result shows, what I have intimated in para. 2, that the local attraction arising from invisible causes hidden in the solid crust of the earth must be such, as very nearly to compensate for the effect produced by visible causes at the surface existing in mountains and oceans. And the second part of the result gives a very satisfactory solution of the problem of the Mean Figure taking local attraction into account, making the semiaxes

$$20926189 \text{ and } 20855316 \text{ feet}$$

$$\text{and the ellipticity} = \frac{1}{295{\cdot}3}$$

5. In the fourth or last section of the Paper I enter into speculations regarding the Constitution of the Earth's Crust, suggested by the result of the preceding section. The following extract will best represent my views on this interesting subject :—

"The first thing I observe in the results given in the last paragraph is the very small amount of the resultant deflections at the two extremities of the Indian Arc—Punnœ close to Cape Comorin, and Kaliana the nearest station to the Himalaya Mountains; whereas the effect of the Ocean and the Mountains has been shown to be very large. This shows that the effect of variations of density in the crust must be very great, in order to bring about this near compensation. In fact the density of the crust beneath the mountains must be less than that below the plains, and still less than that below the ocean-bed. If solidification from the fluid state commenced at the surface, the amount of contraction in the solid parts beneath the mountain-region has been less than in the parts beneath the sea. In fact, it is this unequal contraction which appears to have caused the hollows in the external surface which have become the basins into which the waters have flowed to form the ocean. As the waters flowed into the hollows thus created, the pressure on the ocean-bed would be increased, and the crust, so long as it was sufficiently thin to be influenced by hydrostatic principles of floatation, would so adjust itself that the pressure on any *couche de niveau*

of the fluid should remain the same. At the time that the crust first became sufficiently thick to resist fracture under the strain produced by a change in its density—that is, when it first ceased to depend for the elevation or depression of its several parts upon the principles of floatation—the total amount of matter in any vertical prism, drawn down into the fluid below to a given distance from the earth's centre, had been the same through all the previous changes. After this, any further contraction or any expansion in the solid crust would not alter the amount of matter in the vertical prism, except where there was an ocean; in the case of greater contraction under an ocean than elsewhere, the ocean would become deeper and the amount of matter greater, and in case of a less contraction or of an expansion of the crust under an ocean, the ocean would become shallower, or the amount of matter in the vertical prism less than before. It is not likely that expansion and contraction in the solid crust would affect the arrangement of matter in any other way. That changes of level do take place, by the rising and sinking of the surface, is a well-established fact, which rather favours these theoretical considerations. But they receive, I think, great support from the other fact, that the large effects of the ocean at Punnœ and of the mountains at Kaliana almost entirely disappear from the resultant deflections brought out by the calculation.

This theory, that the wide ocean has been collected on parts of the earth's surface where hollows have been made by the contraction and therefore increased density of the crust below, is well illustrated by the existence of a whole hemisphere of water, of which New Zealand is the pole, in stable equilibrium. Were the crust beneath only of the same density as that beneath the surrounding continents, the water would be drawn off by attraction and not allowed to stand in the undisturbed position it now occupies.

I have, in what goes before, supposed that, in solidifying, the crust contracts and grows denser, as this appears to be most natural, though, after the solid mass is formed, it may either expand or contract, according as an accession or diminution of heat may take place. If, however, in the process of solidifying, the mass becomes lighter, the same conclusion will follow—the mountains being formed by a greater degree of expansion of the crust beneath them, and not by a less contraction, than in the other parts of the crust. It may seem at first difficult to conceive how a crust could be formed at all, if in the act of solidification it becomes heavier than the fluid on which it rests; for the equilibrium of the heavy crust floating on a lighter fluid would be unstable, and the crust would sooner or later be broken through, and would sink down into the fluid, which would overflow it. If, however, this process went on perpetually, the descending

crust, which was originally formed by a loss of heat radiated from the surface into space, would reduce the heat of the fluid into which it sank, and after a time a thicker crust would be formed than before, and the difficulty of its being broken through would become greater every time a new one was formed. Perhaps the tremendous dislocation of stratified rocks in huge masses with which a traveller in the mountains, especially in the interior of the Himalaya region, is familiar, may have been brought about in this way. The catastrophes, too, which geology seems to teach have at certain epochs destroyed whole species of living creatures, may have been thus caused, at the same time breaking up the strata in which these species had for ages before been deposited as the strata were formed. These phenomena must now long have ceased to occur, at any rate on a very extensive scale, as Mr. Hopkins's investigations on Precession appear to prove that the crust is very thick, at least 800 or 1,000 miles; and this result has been recently confirmed by Professor W. Thomson in a paper on the 'Rigidity of the Earth.'"

These results meet with some confirmation from an examination of the direction of the deflection of the plumb-line at several coast-stations where it is drawn *towards* the sea. The amounts of deflection are, however, so small that much cannot be built upon this. This, at any rate, may be said, that they present no obstacle to the theory so remarkably suggested by the facts brought to light in India, viz. that mountain-regions and oceans on a large scale have been produced by the contraction of the materials, as the surface of the earth has passed from a fluid state to a condition of solidity—the amount of contraction beneath the mountain-region having been less than that beneath the ordinary surface, and still less than that beneath the ocean-bed, by which process the hollows have been produced into which the ocean has flowed. These coast-stations do in fact in several instances tend directly to favour the theory, as they seem to indicate, by *excess* of attraction towards the sea, that the contraction of the crust beneath the ocean has gone on increasing in some instances still further since the crust became too thick to be influenced by the principles of floatation, and that an additional flow of water into the increasing hollow has increased the amount of attraction upon stations on its shores.

I am, your's faithfully,

Calcutta, August 2, 1864. JOHN H. PRATT.

Postscript.

[Received 29th April, 1865.]

If the raw or uncorrected results of the Surveys in India and Europe (I mean uncorrected for local attraction) are made use of, they bring out meridians of a slightly different curvature in these different parts of the earth. If these were the true forms of the several meridians the result would be that the equator could not be a circle and the figure of the earth not a spheroid of revolution. A few years ago, General T. F. de Schubert calculated the form of an ellipsoid of three unequal axes which would best suit the observations. Captain Alexander Clarke, R. E. (*Memoirs Roy. As. Soc.* Vol. XXIX, for 1860,) went through the same calculation, following Bessel's method. His result was that the equatorial radius in longitude 14° or thereabouts is one mile longer than that in longitude 104°. He speaks with hesitation regarding the result, on the ground that the data are far too scanty to lead to a conclusion to be relied upon. He appears, however, not to shrink from the hypothesis on which he works, from the true grounds of distrust, viz. (1) the *à priori* improbability that the earth's mean figure is not one of revolution, as the evidence of the fluid-origin of that figure is overwhelming* and (2) that the effect of local attraction is altogether overlooked by him. General de Schubert indeed in a subsequent paper (See *Monthly Notices of Royal Astronomical Soc.* for 1860, p. 264, where it is noticed) does anticipate that local attraction may modify and altogether destroy the data on which he rested the argument of an ellipsoidal figure. The Paper which I have sent to the Society and have noticed in this letter gives, for the first time, a method for estimating the effect of local attraction and proves (in the third section) that so very moderate an allowance as 1″ or 2″ for local attraction will altogether destroy the disparity between the curvature of the different meridians. When the arguments in this paper are impartially weighed I feel convinced that the improbable ellipsoidal theory will be abandoned altogether.

* The evidence, with full details, is given in the third edition of my treatise on the "Figure of the Earth" now passing through the press at Cambridge and a copy of which when published I purpose sending to the Society.

From the above letter it will be seen, that I come to the conclusion that the earth's crust below the mountains is somewhat less dense than below the plains; and still less than below the ocean-bed. Mr. Airy (*Phil. Trans.* for 1854, p. 101) came to the former part of this conclusion. But his argument requires that the crust should be thin—and so thin as to be influenced for its position by the principles of floatation. But Mr. Hopkins' and Prof. W. Thomson's results show that the crust cannot be thin. Moreover Mr. Airy's line of reasoning does not lead to the latter part of the result, in that the crust is more dense below the ocean-bed. For these reasons I have not alluded to Mr. Airy's hypothesis in my Paper. The argument therein explains both these phenomena without requiring that the crust should be thin, but rather the contrary.

Notes to accompany a Geological map and section of the Lowa Ghur or Sheen Ghur range in the district of Bunnoo, Punjab; with analyses of the Lignites.—By Albert M. Verchere, Esq., M. D.

[Received 10th June, 1864.]

Description of the Section, Pl. III.

1. Hillocks or morraines formed by the pebbles and boulders of miocene conglomerates and sandstones which have been removed by the effect of the rains: the sand is carried away to the plain, but the boulders and pebbles are left behind and form a morraine. The stones have arranged themselves in layers resting against the miocene beds, with an inclination towards the plain (W) of 20°.

2. Miocene (?) sandstone, very friable, grey or rather salt and pepper; calcareous and often so soft that it can be crumbled in the hand. It contains boulders and pebbles, well rounded and worn, generally arranged in bands. It is these boulders and pebbles which form No. 1, as No. 2 is being destroyed. The pebbles and boulders are greenstone, quartzite, quartzose porphyry, gypsose agglomerate, carboniferous and nummulitic limestone, etc.

3. Similar to 2, but a little harder, and contains occasionally bands of slate in a state of disintegration. Carbonized wood found here, (seldom,) in an iron-stained sandstone.

4. Harder and greyer sandstone. The bed has been broken up and re-cemented by a coarser, more salt-and-pepper-like sand. The pieces of the original bed are seen sticking out at all angles like drifted ice. On the east side of the valley of Maidani, this breaking up is not observed.

5. Conglomerate composed of yellow limestone pebbles cemented by a very hard calcareous cement. The cement appears first to have coated the pebbles with two or three coats of various shades of yellow or brown, like a calculus of the bladder. This bed is seen always (west of the Indus) on the top of the nummulitic or bottom of the miocene beds. It is striking in appearance, especially when polished by a running torrent.

6. Flesh-coloured, hard, nummulitic limestone, weathering rough, pitted and grey. It contains a few nummulites of small size and a few small bivalves.

7. Limestone, argillaceous and yellow; it is arranged in concentric masses cemented by an earthy marly limestone. Both the rounded masses and the intervening earthy rocks are full of fossils; N. Lœvigata and N. Pushi are abundant; also a small flat species and two species extremely gibbose and always very abundant in muddy nummulitic limestone. Bivalves very numerous. Casts of Trochus very abundant. A large Spatanchus, 6 inches across, found here also.

8. Limestone, glaring-white like chalk and not much harder than chalk. It contains the same fossils as the preceding layer, but no Spatanchus. It is of very great thickness and forms a high white cliff facing the east and remarkable from a great distance.

9. Slate in a state of decomposition. It is interbedded with limestone and occasionally contains small nummulites; but it is generally without fossils.

10. Carbonaceous shale with beds of "Rol" or alum shale and of lignite. The Rol and the lignite beds are generally in contact with the nummulitic limestone above.

11. Shales of all colours, white, red, yellow, grey, olive, nearly black; very calcareous, with thin beds of muddy limestone (very soft) containing debris of shells, rootlets and stems of plants. No nummulites in these beds. Some of these shales are a good fire-clay and are used to make crucibles. These shales are generally more or less wavy.

Examination of the Lignites.

The following samples were given to me by Lieut. Lane, District Superintendent of Police, Bunnoo.

No. 1.—From a seam newly discovered near Chüshmea, north of Moolakhel, 8 miles from the Indus.

Best quality, with a resinous fracture and lustre; jet black in colour; Sp. gravity 1.25.

Volatile inflammable substances,	50
Fixed carbon,	35
Ash,	15
	100

There is a partial caking when the lignite is burnt in a close vessel. The ash is a mixture of a reddish earthy powder, of hardened pieces of slaty shale (holding a little unreduced lignite) and of a fluffy white ash like wood-ash. The red earth and the pieces of shale are mechanical impurities. The white fluffy ash is the proper ash of the lignite.

No. 2.—Best quality, as No. 1. Apparently a very little yellowish white clay adhering to the lignite which is 1½ inch bedded.

From the same locality as No. 1.

Volatile inflammable substances,	50
Fixed carbon,	40
Ash,	10
	100

Same remarks as for No. 1.

No. 3.—Middling quality, the usual quality of the bed. The lignite is in thin plates like leaf bed; each thin plate is sometimes resinous in appearance, but more frequently has the appearance and lustre of charcoal. It contains a considerable amount of yellow clay between the plates. It crepitates in water like salt deflagrating on fire. Its Sp. gravity is 1.28.

From the same locality. Given by Mr. Lane.

Volatile inflammable substances,	25
Fixed carbon,	40
Ash,	35
	100

N. B.—Some of the volatile substances were unreduced in the experiment, and consequently increased the percentage of fixed coal above its proper figure. The ash is mostly a reddish powdery earth with pieces of shale; very little fluffy ash.

No. 4.—Middling quality like No. 3. Structure woody.

Same locality. Given by Mr. Lane.

Volatile inflammable substances,	46.66
Fixed carbon,	20.83
Ash,	32.50
	99.99

Ash, like No. 3.

No. 5. Picked specimen, having the appearance of fine jet. Heavier than the preceding specimens and very resinous in appearance.

Obtained from a native who said that it came from a seam near Sooltan Khel.

Volatile inflammable substances,	46.66
Fixed carbon,	45.
Ash,	8.33
	99.99

The ash was nearly entirely composed of white fluffy ash, like wood-ash. This lignite cakes a good deal in the close vessel.

Average of four analysis of the Chushmea mine.

Volatile inflammable substances,	42.91
Fixed carbon,	33.95
Ash,	23.10
	99.96

I copy here Dr. A. Fleming's analysis of the lignite of Kottree near the Chichalee Pass as it is evidently a continuation of the beds seen a few miles south of the Pass at Chushmea.

Volatile inflammable matter,	36.421
Carbon,	33.579
Ashes,	30.000
	100.000

The coal or lignite from Sooltan Khel (see No. 5) comes nearer to the Baganwallah lignite as analyzed by Dr. A. Fleming. Compare my No. 5 with the following analyses copied from Dr. A. Fleming's report:—

Baganwallah, No. 1.		Baganwallah, No. 2.	
Volatile,	40.64	Volatile,	38.455
Carbon,	41.36	Carbon,	59,705
Ashes,	18.00	Ashes,	1.840
	100.00		100.000

Average.

Volatile,	39.547
Carbon,	50.532
Ashes,	9.920
	99.999

To conclude, I enter here a table of the composition of the lignites of the Lowa Ghur, of Baganwallah, and of the coal of Raneegunj and Sirsol in Bengal and of some coal in the British Islands.

Comparative table of the composition of the Lignite of the Punjab and of the coal of Bengal and of the British Islands.

	Bunnoo.		Salt Range.	Bengal.		Wales.	Scotland.	Wales.		Wailich.
	Chushmea.	Sooltan Khel.	Baganwallah.	Raneegunj.	Sirsol.	Pontypool.	Walls'end.	Bedwas.	Ebbw Vale.	Patent Fuel.
Volatile inflammable matter,...	42.91	46.66	39.547	38.5	36.5	35.18	41.60	28.2[illegible]	22.50	14.89
Fixed Carbon, ...	33.95	45.00	50.532	51.1	52.5	59.3	47.70	64.80	76.0	82.2
Ash, ...	23.1	8.33	9.920	10.4	11.0	5.52	10.70	6.94	1.50	2.91

ALBERT M. VERCHERE.

Scientific Intelligence.

Mr. T. Tomlinson, late Superintendent of the Barrackpore Park, has recently succeeded in hatching an Ostrich by placing the fresh-laid egg in a box lined with straw and exposing it to the sun by day for some weeks, keeping it under a domestic fowl during the night. To prevent one side of the egg being more exposed than the other, it was occasionally turned over. The new born bird is doing well.

Col. Dalton from Chota-Nagpur announces the discovery of a vein of lead in a hill named Puttia near the village of Pelowa, Tuppeh Ramkola, in Sirgooja.

From an analysis of the specimen forwarded by Col. Dalton; it appears to be pure galena with a small trace of silver and the ore is tractable. When fairly cleared, its value would be in England from 12£ to 13£ per ton. An attempt to work the mine was made, but the outturn not proving profitable, it was abandoned.

The following is from our late Curator :—

Belmont, St. Briavel's,
W. Gloucestershire, Dec. 2, 1864.

My dear Grote,—In the *Reader* for November 19th, you will read that a paper was read by me at the Zoological Society on November 8th; but I was not there, having left a short paper with Sclater. In the *Proceedings*, p. 335 of our Journal, I observe '*Felis Jacquemontii*' mentioned. This I consider to be merely the longer-furred mountain variety of *F. chaus*; *F. ornata* too, I now refer to *F. torquata*, *F. Cuv.*; and *celidogaster* turns out to be African, and distinct from *viverrina*, *F. torquata* of Sykes being a striped domestic Indian cat,—at least identical with the latter, whether or not descended from domestic stock. A dead Tiger from Barrackpore is mentioned in the same page of the Journal. I hope this was skeletonized, because I could get you a *Megaceros* skeleton in exchange for it! Lastly, about the "new species of *Varranus*" in the same page, I presume this to be the *Hydrosaurus* noticed by me from the Andamans and Nicobars, which I could not perceive to differ *structurally* from *H. Salvator*. I suppose

you have received Günther's work on Indian reptiles, which will materially assist the study of them. I do not, however, agree with him in all cases; for instance, his identification of the Bengal *Emys ocellata* with the Tenasserim *E. Berdmorei.*—He has certainly not seen specimens of the former, and I wish that some could be sent to him. The species is not very commonly brought to the Calcutta bazar, but by offering a slight reward to one of the museum servants a few might be obtained, and there is a good series of both races in the Society's museum. I have written pretty regularly to Jerdon, communicating to him what I learn; but he has not largely availed himself of my notes in his Appendix, and I seldom hear from him. He never was a good correspondent. I certainly told him in good time for publication that the common Indian Curlew is not *Numenius arquata*, but *N. major*, Schlegel, figured in the *Fauna Japonica ;* and I sent British specimens of the former to the museum. He is quite wrong, too, in placing the Burmese Peafowl in Asám! The Indian species occurring so far round as Chittagong. The *Gallus Temminckii*, Gray (p. 541,) which he mentions as a peculiar species, is a most obvious hybrid between *bankivus* and *furcatus*, though differently coloured from the so-called *G. æneus.* In p. 481, he is quite wrong in identifying *Turtur chinensis* with *T. tigrinus :* the former is much larger, with quite plain plumage on the back, and is correctly figured by Sonnerat. Both are in the Society's museum. I cannot make out the middle-sized Indian Cormorant erroneously referred to *sinensis* in p. 862. P. 870, l. 3. For "*poliogenys*," read *pyrrhogenys.* P. 597. *T. ocellatus*, the Philippine species (*luzoniensis*, Gm.,) is quite distinct from the Indian *T. pugnae*, to which Jerdon's other synonyms belong. *Arboricola rufogularis*, (p. 598) was sent by Tickell from *Tenasserim*, as noticed in one of my Reports. Another time I will annotate Jerdon's work for you in detail. About the Darjeeling Kalij Pheasant (*melanotus*), these breed at the Gardens, and are distributed, but not any have died, to be promoted to the British Museum. A good pair of skins would accordingly be acceptable. Bruce has sent from China a noble pair of skins of *Crossoptilon Mougolicum*, Swinhoe, (*auritum*, Pallas, apud Sclater,) and ditto of a new species of *Pucrasia*, *P. xanthospila*,. E. R. Gray, from the mountains N. W. of Pekin. The sexes of the former only differ in the male being larger

and spurred. Hodgson's *Cr. tibetanum* still remains unique, I believe. The localities assigned to many specimens in the British Museum are unreliable. Thus the Burmese lineated or pencilled Kalij is assigned to Bootan, and various Tenasserim squirrels, also to Bootan, all doubtless from the same collection, but received with the erroneous locality from the old India-house. The distinctions we recognise between Indian, Indo-Chinese and Malayan *faunæ* are little understood by naturalists here who will have *all* alike, to be *Indian*. Günther's *Indian* reptiles, for example. About Sikhim and Asám monkeys. I look upon *assamensis* (original specimen in India museum,) as a mere variety (not unlikely an *individual*, var.) of *rhesus*, wanting the fulvous hue of the hair on the hind-parts. *M. pelops* I know little of, but Jerdon should get this at Másuri. Of the Lungoors, I know nothing of more than one Himálayan species, which is Hodgson's *schistaceus*. Does true *entellus* range, into Asám, and is it not the Hunumán of the table-land of S. India? Is not *priamus* peculiar to the ghâts and mountainous country, as *Johnii* (verus) is certainly peculiar to the W. ghâts? I do not remember who wrote the Review of Jerdon's work in the Annals, and cannot refer to it here. Smythe has yet to shoot the Shau, and perhaps the Tibetan Lynx. Is it the *wild* yak he thinks of sending home alive? The tame breed here as regularly as domestic cattle. A young bull was calved last year, and a cow this year, at the Zoological Gardens; both females hornless. Pallas refers to wild two-humped camels in the Mongolian deserts; and not many years ago the existence of wild yaks was doubted by Hutton and others. In the long stretch of desert country between the Red Sea and the valley of the Nile wild one-humped camels are numerous; and I see no reason why these should not be aboriginally wild, like genuine *Asinus vulgaris* in Africa (the *a. tœnispus*, Henglin). There is a fine male of the latter now in the Zoological Gardens, a most decided and unmistakeable true donkey or *Onager;* and the series of wild asinine animals (including zebras) is complete, every known race or species being represented. All of the animals brought by Thompson were alive when I left London and the Hornbills in first rate condition. The *Aceros nipalensis* would be a grand prize; have not *both sexes* the rufous plumage in the nest? Reversing the usual arrangement, in *Rhynchœa* and in *Turnix pugnax*, the adult females are the

more ornamented, and the young resemble the old males! The old she-rhinoceros soon made friends with the young ones, but is kept separate from them. *Bos sondaicus* did not die from the injury to the foot. That was a very slight affair and soon over; there was a 'gathering,' when the animal walked lame, and he recovered as soon as it was lanced. He grew much, and became in fine condition, and when he died the mass of thickened cuticle had begun to form between the bases of the horns; but the colour of the coat had not begun to blacken. Poor fellow, he is now admirably stuffed, in the *B. M.* He died of inflammation of the bowels. In the Zoological Gardens, are one pair *Arboricola torqueola*, two pairs *Ortygornis gularis*, and one pair of each Indian species of *Galloperdix*, all in first-rate health and condition. The 'blood-pheasant' (*Ithaginis cruentus*) from interior of Sikhim, is a great desideratum. A young African wild boar (*S. Scropha* vera) has been put to *S. Andamanensis*, but I believe with no result as yet. I suppose there is no chance now of getting a boar of the Andamán race. Thanks for the Darjeeling Shrews and Bats, which I look forward with interest to see. F. More, when I last saw him, was mainly interested in insects of economical value, as honey-bees, &c. Has the hive bee of Kashmir ever been scientifically examined? It is likely enough to prove as distinct as the Ligurian Bee. Just before I left London I saw, with Wolf, in spirit, a most curious new mammal, sent by Du Chaillu from Fernando Po. It is an Otter-like modification of the order *Insectivora*, and the most distinct new genus of mammal that has turned up for a long time. It will be figured and described in the forthcoming Number of the *Tr. Z. S.* Size of a large stoat, but more bulky, with tail exceedingly tumid at base, laterally flattened for the remainder. Whiskers very copious, thick and coarse, as in *Cynogale Bennettii*. Eyes small. Two of the hind toes connected, as in so many marsupials. General appearance, colour and fur, very otter-like. Front teeth hooked, approaching to Sorex. Alphonse Milne Edwards has published a monograph on the Chevrotains, upon which part of my note bears. I have sent the particulars to Jerdon, and by the way I wish Jerdon would contribute to the Journal a selection from the many notes that I have sent him. There are two groups of Chevrotains (united by A. Milne Edwards,) viz. *Meminna* of India

and Ceylon, and *Tragulus* of the Indo-Chinese and Malayan countries, —for *M. malaccensis*, Gray = *M. indica*. Of *Tragulus*, there are 3 large races and 3 small, as follow :—

Large

1. *Tr. napu*, F. Cuv. = *javanicus* apud Gray and Cantor. One specimen in Calcutta museum.
2. *Tr. Stanleyanus*.
3. *Tr.* (like last, but with black sides of neck and breast-marks; in Calcutta museum ♂ ♀, and unknown here.)

Sm

4. *Tr. javanicus* (verus) = *pelandoc*, nobis, from Java only, I suspect, and one ♂ only in Calcutta museum. Numerous specimens in Liverpool museum.
5. *Tr. kanchil*. Extends to S. Tenasserim.
6. *Tr. affinis*, Gray, placed as a synonym of *Kanchil* by Edwards, and the original specimen so named by Gray, from Malacca, is just a *Kanchil* wanting the medial breast-stripe; but others sent by Mouhat from Cambodia appear to be a distinct race, whatever name it may bear. The Society's museum has all but the last, and the specimens should be re-labelled according to this present determination of them.

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PART II.—PHYSICAL SCIENCE.

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Remarks on the Vegetation of the Islands of the Indus River.—*By* J. E. T. AITCHISON, M.D., F.R.C.S.E., F.L.S., *Extr. Member, Royal Med. Soc., Edin., &c., Asst. Surgeon, Bengal Army.*

[*Received*, 18*th March*, 1864.]

As much interest is being attached to the local production of fire-wood for the use of the steamers that ply on the Indus river, I have the honor to forward the accompanying notes taken during a passage made up that river and its tributary, from Kotree to Mooltan, on board the steamer 'Havelock,' Capt. Davis, Commander, which left Kotree on the 29th of August and reached Mooltan on the 16th of September.

The river at the time of starting was at its highest, inundating much of the country and causing an immense number of islands to be formed in its course.

It is the vegetation of these islands I would describe. It is not very extensive, but what there is of it is turned to much account and might be to more.

The following is a list of the Flora met with, viz.:—

Acacia Arabica, L.
A. Arabica, var *Cupressina.*
Prosopis spicigera, L.
Populus Euphratica, Oliv.

Tamarix Indica (= T. Gallica, L.)
T. Dioica, Roxb.
T. Orientalis.
Phœnix Dactylifera, L.
Saccharum Munja, Roxb.
S. spontaneum, L.
S. cylindricum, Lam.
Typha (angustifolia ?)

Creeping amongst the above, climbing to the top of all, shewing off its lovely flowers, was Asclepias rosea, Roxb. in great beauty.

Acacia Arabica, 'Bubber' (Scindee,) 'Babool' (Hind.) 'Kekur' (Punjabee). *A. A. var Cupressus*, 'Caublee-bubber' (Scindee).

This tree with its variety grows in very great luxuriance and tolerably rapidly, and within 60 miles of Kotree it is in much greater abundance than further up the river; it here forms dense jungles and yields very fair timber. The tree itself is too valuable to be directly used for firewood, its chief timber being used for railway sleepers; the rest of the wood and branches only are converted into firewood or charcoal, and the bark and fruit reserved for tanning purposes.

A tree (as it stands) that can yield from two to three sleepers, costs one Rupee, the buyer felling and carrying it away. White ants do not injure the felled logs much, and the old wood is tolerably proof to their attacks.

The timber of the Cupressiform variety is considered the better, being closer in grain, and harder than that of the common outspreading tree: being also of greater length, and thus generally giving an additional sleeper.

Prosopis spicigera, 'Kunda' (Scindee,) 'Jand' (Punjabee).

This tree is not common on the Balaas; indeed it is scarcely to be seen in any quantity until we get above Sukker, and then chiefly on the mainland, where it is obtained largely, especially at one of the river wood stations called Jummalee.

Its wood is good for fuel, but alas, too readily attacked by white ants. These insects seem to relish it more than any other of the woods, and from the great loss it suffers from these destructive insects

whilst stacked, its collection for the supply of the steamers is prohibited.

For the reasons given against its being stored for fuel, its timber is likewise not used by the natives for any purpose whatever, when other can be obtained.

The fruit, however, called in Scindee "Singhar," is considered an excellent vegetable, and is largely eaten by the natives in their *thurkaries.*

Populus Euphratica, 'Bahn' (Scindee and Punjabee,) grows in great abundance on the Balaas, but more especially about a hundred miles above Kotree. It is a rapidly growing tree, producing very fair timber, with a white light wood, very useful for furniture and household-work of a light nature, but which does not stand much strain. It is a very dangerous article as fuel in steamers, or when used for the railway, as the wood, owing to its lightness, flies up through the flue when only half burnt. The officers commanding the steamers are very careful that none is ever taken on board, even by mistake, from the danger attendant on its use.

The timber for furniture costs about 5 annas a cubic foot.

Tamarix Indica, 'Laee' (Scindee,) 'Jhao' (Hind.) 'Furash' (Punjabee).

This may be considered as the chief source of firewood from Mooltan to Kotree. It grows in immense quantities, but above the union of the five rivers with the Indus, it becomes gradually replaced on the Balaa land by the *T. dioica* and it becomes more abundant on the mainland, where we find the *T. orientalis* also occurring, but as a very much larger tree. These were all in blossom in September, presenting a very heath-like appearance just before the flowers expanded. The *T. Indica* like all its congeners, grows very rapidly, producing in three or four years a deep red wood, very much like the Beef wood of Australia. At this age it is best for fuel: the white and young wood makes but poor fuel, and is also rapidly destroyed by the white ant; whereas the red wood may lie for nearly four years without injury; but as it becomes completely dried and aged, it becomes more liable to the attacks of these insects. The cost of this wood at the river stations is 15 Rupees for 100 maunds.

Tamarix dioica, 'Pilchee,' (Scindee and Punjabee,) first met with in any abundance on the Balaas near Bukree; above that station it gradually takes the place of *T. Indica.* It is greatly used for all thatching purposes, basket-work, &c.

Tamarix orientalis, 'Asree-loua' (Scindee,) is an unknown tree on the Balaas, but on the mainland it not unfrequently forms a prominent object in the landscape, generally near villages. The tree lives best in a dry and salt soil, where it very rapidly produces large timber, but this does not make such good fuel as the *T. Indica.*

The native names of these Tamarisks are much confounded even by the natives themselves. The name 'Furas' in the Punjab is applied to all, but chiefly to *T. Orientalis.* They are so very much like each other that this is not to be wondered at. Edgeworth, in his Flora Mallica, calls *T. dioica*, 'Lai,' and *T. Gallica* (= *T. Indica*) 'Pilchi.' I would consider the Scindee names as typical, from their being connected with something further than simply the tree as it grows, viz. in the one case the value of the wood for fuel, *T. Indica*, 'Laee,' 'Jhao;' in another the use of the shrub for thatching purposes and the known fact of this kind never producing wood, *T. dioica*, 'Pilchee;' and lastly with the fact that it forms a large tree, the wood of which is not so good for fuel, *T. Orientalis*, 'Asree-loua.'

Phœnix dactylifera, is occasionally to be seen on the Balaa land between Sukker and Mooltan, where it is very common on the mainland also. A splendid grove of these trees, surrounding Sukker, is seen from a long distance off. After leaving Kotree some forty miles, we see none of this tree until Sukker comes in sight, whereas round Kotree it is very abundant, and at and near Mooltan it is also very abundant.

Saccharum Munji, 'Moonj,' (Scindee and Punjabee). Thousands of acres of river land are covered with this useful grass, the value of which might be greatly raised by the introduction of machinery for converting it into pulp for the Paper Maker. And Sukker would be the place for starting such an establishment, as it grows chiefly above Sukker, to which place it could be floated down the river at little or no cost. This very floating down would aid in the treatment required by all fibres to bring them into a fit condition for working. The surrounding country yields immense quantities of an Alkali

(Sugee-muttee) with which the material could be cheaply bleached, then to be forwarded to England, to be converted there into finer pulp and paper.

The great outcry at home since the commencement of the cotton famine has been for material, capable of being converted at a cheap rate, into paper of a fine quality. Coloured materials require much bleaching, and this in England is the expensive part of the process. Now if such a material as Moonj, which costs at the place of growth little more than the labour of cutting, could be bleached thoroughly with the alkali produced on the banks of the river, this would supply the great desideratum of the paper-makers.

Esparto (*Stipa tenacissima*) has been very largely used in England within the last three years, but its great drawback is the expense of bleaching it.

The Moonj is largely employed by the native boatmen in making ropes for their boats, which they manufucture for themselves.

Saccharum spontaneum, 'Khaus' (Scindee.) This grass grows in great luxuriance. It is chiefly used for thatching purposes, and makes tolerably good grazing for cattle, although as it ages it becomes a very rough coarse grass, when the cattle seem to leave it alone. It begins to flower early in September, and its flowering has just ceased, when the *S. Moonja* commences to flower, which is about the beginning of October.

Typha (angustifolia?) 'Pun' (Scindee,) is very common in the back waters, but more especially above Sukker. I cannot say it is even common below Sukker. The leaves are largely used for making matting (chuttie) and the soft down attached to the ripe fruit is used for stuffing pillows. The pollen is said by Lindley to be converted into bread in Scind. Although I made many enquiries relative to it, I could get no information about it.

On examining the wood brought on board the steamer, (about which Capt. Davis gave me every information and assistance in his power,) I found that nearly the whole of it consisted of the wood of the *Tamarix Indica*, and the wood was called Jhao. We occasionally took on board that of the *Acacia Arabica* called 'Bubber.' But I had to procure specimens of that of the *Prosopis Spicigera* called 'Kunda,' and of the *Populus Euphratica* called 'Bahn.'

The Captain considered the billets that were large enough to be split into two, of the Jhao, when it was "as red as beef" as the best wood on the river. But his heart used to long for the wood he once got when up the Jhelum river. "*Cows*, that's the thing for driving the engines." *Olea Europea*, 'Cow' (Punjabee.)

Immense injury is done to the wood after it is collected at the wood stations, by white ants, which will, in a very few days, if not carefully looked after, destroy a stack, leaving a mass of mud in place of the original wood. White ants will not attack the Jhao, if the wood is red, to the same extent that they do the other kinds of wood.

The soil of the Islands varies very much. It consists nearly altogether of a rich alluvial deposit at Kotree, gradually becoming more sandy as we ascend the river. This change to a sandy soil is very much more marked above Sukker, after which the soil really seems to be all sand with no earthy matter. Owing to this change in its composition as we gradually get above Kotree and approach Sukker those massings of the *Acacia Arabica* that we had down the river become less numerous and thinner: until at last by the time we have reached the junction of the five rivers with the Indus, we lose them altogether, as well as the *Tamarix Indica*, which is now replaced by the *T. dioica*. Moonj gets abundant above Sukker and the Islands are very much less wooded, being more covered with grasses.

I have no doubt that much of this river land which at present really lies waste, might be, with a little care and management, covered with trees capable of yielding both timber and firewood. We should look to timber as the ultimate object; in doing so, we obtain firewood as a collateral result. In covering these islands with vegetation we aid in rendering them somewhat more permanent than they are at present, by the roots grasping and keeping together the soil.

The following may be considered the history of one of these islands that may have remained permanent.

In the month of September as the river falls, a mound of sand gradually appears, enlarging daily as the river becomes lower, and bare and barren. But as the September winds blow, they carry clouds of the seed of the *Saccharum spontaneum* from other islands; these fall on the soil and then readily germinate. In a couple of months the

S. spontaneum has sprung up, and its leaves now aid in catching the seeds of the *Tamarix* and *S. Munja*, which having ripened, are flying about at the mercy of the winds. The two latter lie dormant until the next year. In the meanwhile the *S. spontaneum* for a short time kept down by the cold season and eaten over by the cattle, has its growth stopped until March or April, when it springs up, and by September is in its full growth and blossom. The *Tamarix* and *S. Munja* being now, on the rising of the river in August, placed under favourable circumstances, begin to grow rapidly, and by the end of the second year cover the Balaa, killing out *S. spontaneum* to a great degree. Upon the island being flooded at the end of the second year, the vegetation on it catches the seeds floated down by the river, and these in their turn germinate and gradually develope a jungle. At very little expense, indeed, many of these Balaas might be sown broadcast with the seeds of timber trees, (*Acacia* or 'Sissoo' are undoubtedly the best) about the beginning of August. When the river rose it would cover the islands and deposit sufficient alluvial soil to permit their germinating and taking root. The seeds would not be carried off by the currents, as they become entangled in the grass, which after an inundation is generally seen pressed flat to the surface with a large amount of alluvial deposit keeping it down.

Developing jungles on these islands, would not only supply timber, firewood, &c., but by making the islands permanent, would to a great extent assist in forming a permanent channel for the river, the absence of which is one of the great difficulties to be overcome at present by the navigator.

Observations on certain strictures by Mr. H. F. BLANFORD, *on my Paper on the distribution of Indian Gasteropoda in J. A. S., No. CCLXXXIX. Page* 69.—*By* W. THEOBALD, *Jr.*

(Received 21st May, 1864.) (Read 1st June, 1865.)

My friend Mr. Blanford, loc. cit., after reading the above paper, among other remarks, expresses himself as follows :—"The sporadic origin of species is not held by any eminent naturalist of the present day, and Mr. Theobald had advanced no instance in its favour."

Now the peculiar distribution of a few species over an enormous area, was the reason for my preferring the supposition of a sporadic origin for them at least as the only intelligible one, and if for the majority of species, this view is not so imperatively requisite, yet for such species as *Bulimus pullus*, *B. punctatus*, *B. gracilis*, *B. cœnopictus*, and others, it naturally suggests itself, though I doubtless must have expressed myself so badly as to warrant Mr. Blanford in denying my having "advanced any instance in its favour." Rejecting however, the obvious view, as I hold it to be, of sporadic origin, it yet remains to be seen what explanation consonant with the Darwinian hypothesis, can be offered, and I shall eagerly listen to Mr. Blanford's suggestions on this point.

I see of course, that in terming the origin of any species "sporadic," I explain nothing, and that it amounts to a confession of ignorance, still this is a negative evil and leaves the ground clear for any superstructure which fresh light may enable us to add, but not so a positive assertion of a law, which, however, applicable in some cases and true to some extent, does not meet all, and appears contradicted by some. I will now advert to the first portion of Mr. Blanford's stricture to the effect that I held views which no eminent naturalist did, and certainly such a statement was not encouraging, but on returning to station within the last month, I accidentally came across a work which considerably reassured me; though how far Mr. Blanford will admit the names of A. A. Gould and Louis Agassiz to be eminent in their department, after the quotation I shall presently make, I cannot say. Any how I find in the "Principles of Zoology" by those Professors, my identical theory

laid down, on precisely the same grounds of certain peculiarities in the distribution of Fish, which appeared to me (though unhappily not to Mr. Blanford) so convincing in the case of the Land Shells of India.

So identical are the results and the proofs in either case, that I think it necessary to say, that till the present month, I had never seen the work I am about to quote from, or any writings whatever of either Gould or Agassiz, and that my views of the sporadic origin of certain species of shells were deduced from considerations touching their distribution, and in ignorance of similar arguments, derivable from the study of an entirely different class.

The following quotation from page 211 of the Principles of Zoology will prove how closely the estimate I formed of the practical effects of accidental distribution, corresponds with that held by Gould and Agassiz.

"448. Other causes may also contribute towards dispersing animals. Thus the sea-weeds are carried about by marine currents and are frequently met with far from shore, thronged with little crustaceans which are in this manner transported to great distances from the place of their birth. The drift wood which the Gulf Stream floats from the Gulf of Mexico even to the western shores of Europe is frequently perforated by the Larvæ of insects, and may probably serve as depositories for the eggs of fishes, crustacea and mollusks. It is possible also that aquatic birds may contribute in some measure to the diffusion of some species of fishes and mollusks, either by the eggs becoming attached to their feet or by means of those which they evacuate undigested after having transported them to considerable distances. *Still all these circumstances exercise but a very feeble influence upon the distribution of species in general, and each country none the less preserves its peculiar physiognomy so far as its animals are concerned.*

"449. There is only one way to account for the distribution of animals as we find them, namely to suppose they are *autochthonoi*, that is to say that they originated like plants, on the soil where they are found. *In order to explain the particular distribution of many animals, we are even led to admit that they must have been created at several points of the same zone, an inference which we must make from*

the distribution of aquatic animals, especially that of fishes. If we examine the fishes of the rivers of the United States, *peculiar species will be found in each basin, associated with others which are common to several basins.* Thus the Delaware river contains species not found in the Hudson. But on the other hand, the pickerel is found in both. Now, if all animals originated at one point and from a single stock, the pickerel must have passed from the Delaware to the Hudson or vice versâ, which it could only have done by passing along the sea shore or by leaping over large spaces of terra firma; that is to say, in both cases it would be necessary to do violence to its organisation."

This last argument must of course stand for what it is worth, and were it alone, would not be worth much, but we have here, with fish, as I have shown to be the case with Gasteropods in India, the grand fact of certain few species of enormous range, compared with the limited extent of their more numerous congeners and the absurdity of supposing that they have been thus widely distributed by any physical agency, which has left the *great majority unaffected by its operation.* Hence my reasons for leaning towards the "sporadic" theory, for some species at least, not *singly* at all events, I am glad to see, if however, in company with no other physiologist than Louis Agassiz. I cannot conclude these observations without quoting a passage from the vitriolic pen of Dr. Knox, in his work on Race, where, though he holds that "Time and developement change all things" (page 94,) yet is very bitter on the absurdity of supposing that ACCIDENT has anything to do with such changes. Knox on Race, page 90, "When I am told that there is a short-legged race of sheep somewhere in America, the product of accident, my reply is simply, I do not believe it, even although to make the story look better, it has been added that from among the few short-legged sheep *accidentally* produced in the flock, the owner was careful to extrude the long-legged ones, and so at last his whole flock became short-legged, *and he had no more trouble with it.*—It is the old fable of Hippocrates and the Macrocephali reduced to something like a scientific formula. Transferred from sheep, it has been made the basis of a theory of race of mankind, reducing all to *accident.* By accident a child darker than the rest of the family is born; when this happens in the present day, it is also by courtesy called an accident, but its nature is well

understood—not so in former times. This dark child a little darker than the others separates with a few more from the rest of the family and sojourns in a land where a hot sun embrowns them with a still deeper hue. In time they become blacker and blacker or browner and browner. Should they travel north instead of south, it is all the same; for extreme cold produces the same effect as extreme heat! This is ancient and modern physiology!"

Note relating to Sivalik Fauna.—*By* H. B. Medlicott.

[Received 7th September, 1864.] [Read 7th September, 1864.]

The notice I have to bring before the Society may be considered a continuation of a series of brief but important communications, commenced more than thirty years ago, and continued during some twenty years, as recorded in the volumes of the Journal of the Asiatic Society for that period. Those communications formed a current chronicle of the discovery of the *Fauna Sivalensis.* Had the account of those discoveries ever assumed a more connected and complete form, the correction I have now to make, would never have been needed, as it is but the statement of a fact, of which the evidence was in hand and in mind, although never expressed. Indeed, for the same reason, this fact can now be only indicated, its value being still unknown. This fact is—the existence of two vertebrate faunæ, possibly quite distinct, among the fossils hitherto collected from the so-called Sivalik rocks.

In a recently published number of the 'Memoirs of the Geological Survey of India, Vol. III. Part 2, I have given a somewhat detailed account of the geology of the Sub-Himalayan region in North-West India. I therein established a threefold division of the great series of deposits coming under the general title of Sub-Himalayan. Concerning the lowest of these groups (Subathu, etc.) little or no conflicting evidence presented itself. The two upper groups I described as in all respects more akin to each other, although still most clearly separable along a well marked boundary, at which the younger strata overlap the steeply denuded edges of the older, besides being

largely made up of their debris. Such evidence is so immutable to the geologist, and, when on so grand a scale, entails such grave considerations of time, that I presumed to call in question the one published statement (in Vol. III. p. 527 of the J. A. S. B. for 1834) of vertebrate Sivalik fossils having been found within the area of the older groups, not having myself succeeded in re-discovering fossils at the locality indicated. My scepticism was of course based upon the *a priori* consideration of geological time; and because, as I state at p. 105 of my Memoir, no corresponding distinction has as yet been suspected by the authors of the *Fauna Sivalensis.* I made due attempts to authenticate the observation which I had called in question by referring to the original discoverers; as, however, in every reply I received, there was some trace of ambiguity, not wishing to give further trouble to my correspondents, I published the whole case in its unsettled form, giving full directions for the application of the verdict on either side (see pp. 15, 16, 104—6, of my Memoir). I have now the pleasure to announce this verdict; and, notwithstanding the precaution I took to provide for its application, the fact cannot well be stated without a few words of explanation.

In a letter dated the 16th July, 1864, Sir Proby Cautley tells me that he has himself collected fossils on the north side of Nahan *i. e.* in the rocks of my middle group, the same in every respect as those he had found more abundantly at the south base of the Sivalik hills, east of the Jumna. The peculiar mode of occurrence of these fossils in the nodular clays ('clay-conglomerate' of Cautley), as compared with those found in the coarse gravel deposits, could not escape observation. The former were all small and fragmentary. Large masses of the clay had to be carted from the hills and broken up at leisure in search of the fossil remains. I need scarcely, however, state that the Sivalik fossils have hitherto been given and received as one undivided fauna. Every one interested in these subjects will join in the regret expressed by Sir Proby Cautley that it is now impossible to work the question out, unless upon fresh materials. He informs me that the large collection of these smaller fossils, sent by him with the others to the British Museum, is now not to be found.

To palæontologists then, we may now announce that a most interesting case awaits their investigation, namely, the comparison of well

represented vertebrate faunæ, occurring in a series of beds, closely related in point of geological conditions of deposit, etc., and yet distinctly separated (broken) in time.

The application of the fact to stratigraphical geology may now take shape. The strata at the base of the sections visible in parts of the Sivalik hills are representations of the Nahun group—the middle group of the Sub-Himalayan series. The expression of this on a map must still be arbitrary: for the true Sivalik strata (though so strongly unconformable with the 'Nahun' strata along their junction with the inner zone of these Nahun rocks,) appear to pass conformably and even by gradation into the representatives of the Nahun strata in the outer zone. It is of course to be expected that a very close study will reveal traces of this unconformability in the sections of the Sivalik hills also; but in such massive, banked strata, from twenty to two hundred feet thick, the determination of such a feature will be very dubious.

In physical geology this feature will be only another example, on a larger scale than those given in my Memoir, of the supposition I have offered in explanation of the mode of disturbance of all these Sub-Himalayan rocks—slow contortion and upheaval along narrow zones synchronously, with more or less uninterrupted deposition in the adjoining exterior area.

Contributions to Indian Malacology, No. V. Descriptions of new land shells from Arakan, Pegu, and Ava; with notes on the distribution of described species.—*By* WILLIAM T. BLANFORD, *A. R. S. M., F. G. S.*

[Received 11th March, 1865.]

ORDER,—PULMONIFERA.

Family *Helicidæ*.

GENUS NANINA.

Section *Macrochlamys*.

1. N. COMPLUVIALIS, n. sp.

Shell perforated, subglobosely depressed, thin, light-coloured, horny, smooth, polished, diaphanous, very minutely striated. Spire convex; suture in a deep and rather broad groove, which becomes obsoleté at the apex. Whorls $4\frac{1}{2}$, convex, sharply angulate above at the edge of the sutural groove; the last not descending near the mouth. Aperture, oblique, irregularly lunate, of the same form as the whorls, nearly equal in height and breadth; peristome thin, in one plane, simple; margins distant, columellar briefly reflexed at the perforation.

	Millem.	inch.
Major diameter, ...	10	0.4
Minor ditto, ...	9	0.36
Axis, ...	$6\frac{1}{2}$	0.26

Aperture 5 millem. broad.

Habitat—Arakan hills.

This shell is closely allied to *N. convallata*, Bens. of the Tenasserim provinces, and replaces that shell in Arakan. It is distinguished by the smaller number of whorls, while the singular sutural channel is even more developed, but it varies slightly in size.

2. N. NEBULOSA, n. sp.

Shell minutely perforated, conoidly depressed, thin, light horny, not polished, minutely striated, and possessing a dull greasy lustre. Spire conoidal; apex rather acute; suture impressed. Whorls 6, convex above; the last rather broader, subangulate above the periphery rounded beneath. Aperture slightly oblique, lunate, the breadth greater than the height; peristome simple, thin; columellar margin vertical, slightly reflexed.

	Millem.	inch.
Major diameter, ...	$11\frac{1}{2}$	0.46
Minor ditto, ...	10	0.40
Axis,..........................	6	0.24

Aperture 6 millem. broad, $4\frac{1}{2}$ high.

Habitat—Akoutoung on the Irawady, below Prome, Pegu.

This species may be distinguished from its numerous allies of the *Macrochlamys* section by its blunt angulation at the periphery and its dull lustre. Its nearly vertical mouth amply serves to shew its distinction from *N. honesta*, Gould, which shell moreover is more polished, and differs in several other particulars.

3. N. HYPOLEUCA, n. sp.

Shell openly perforated, depressed, very thin, smooth, polished, horny; dark brown above; lighter, frequently white below; faintly striated, obliquely above, radiately below, with extremely fine concentric microscopic markings, which are frequently obsolete. Spire very little raised; apex rather obtuse; suture impressed, sometimes sub-marginate. Whorls 5, rather convex above; the last rather broader, rounded beneath, not descending. Aperture lunate, the breadth exceeding the height, nearly vertical; peristome acute, straight; columellar margin descending with an oblique curve, scarcely reflexed.

	Millem.	inch.
Major diameter,..................	12	0.48
Minor ditto, ...	$10\frac{1}{2}$	0.42
Axis, ...	6	0.25

Habitat—Akoutoung, Pegu. Scarce.

Near *N. causia*, Bs., but larger, more depressed, and with far finer microscopic spiral sculpture; so fine indeed that it is difficult of detection even under a powerful microscope. *H. hypoleuca* may be recognised by its pale base, and dark horny colour above, and by its open perforation.

A small form, perhaps identical with the above, but only 5 or 6 millemetres in diameter, is common in northern Pegu. I had confounded it with *N. causia*, Bens., but Mr. Benson informs me that

that species is very different. This small form differs from *N. hypoleuca* in its more marked spiral sculpture, which, however, is still microscopic.

Section *Hemiplecta.*

4. N. UNDOSA, n. sp.

Shell narrowly umbilicated, depressed, rather solid, white (? horny when fresh,) peculiarly marked with irregularly sinuous close spiral sculpture resembling scratches, and crossed by oblique lines of growth. Spire very depressly conoid; apex obtuse; suture impressed. Whorls 5, rather rapidly increasing, somewhat convex; the last broader, rounded at the periphery and below; the spiral sculpture passing over the periphery and gradually dying out on the lower surface, which is marked by radiating striæ. Mouth diagonal, broadly lunate, equally broad and high; peristome simple, acute; margins distant, united by a callus; columellar margin oblique, shortly reflexed above.

	Millem.	inch.
Major diameter,..................	36	1.45
Minor ditto, ...	31	1.24
Axis, ...	21	0.84

Aperture 18 millem. broad.

Habitat—Shan Hills, east of Ava. Distinguished by its peculiar sculpture; which somewhat recalls that of *Nanina Humphreysiana*, Lea. All the specimens found were dead and bleached; fresh specimens possibly possess a coloured epidermis.

Section *Sesara.*

5. N. HELICIFERA, n. sp.

Shell imperforate when adult, but with a deep umbilical hollow; young specimens deeply perforate; conoidly trochiform, subcampanulate, thin, horny, sharply and arcuately costulated above, the costulation continuing over the periphery; smooth, polished and finely striated beneath. Spire conoid, sides convex; apex rather obtuse; suture impressed. Whorls 7—7½, closely wound, convex, increasing very slowly; the last angulate at the periphery in adults, sharply keeled in immature specimens, flattened beneath, more convex near the mouth, with one or two small, irregularly shaped indentations, (which are mostly opaque from a coating of white callus within the shell), on the lower surface, generally at a distance of about ½ a whorl from the

mouth. Aperture oblique, lunate, the breadth double the height, columella furnished with a spiral lamina which runs throughout the whorls, and renders the shell opaque around the umbilical excavation. Peristome simple, very slightly thickened inside, arcuate at the base of the right margin; margins distant, the columellar oblique.

	Millem.	inch.
Major diameter,..................	10	0.4
Minor ditto, ...	9	0.36
Axis, ...	7	0.28

Aperture 4 millem. broad, 2 high.

Animal small with a very narrow foot, a very small mucus pore at the end, and a small lobe above.

Habitat—Arakan hills near Prome; more abundant on the Arakan than on the Pegu side.

This very pretty little snail, which is nowhere common, is remarkable for the screw like lamina on the columella, running up throughout the whorls. The indentation on the base of the lowest whorl is also peculiar; it varies considerably in position and form, being sometimes double, but it is almost always present. The animal bears a great resemblance to that of *Nanina pylaica*, Bs.

The subgenus *Sesara* was founded by Albers for *Nanina infrendens*, Gould, (supposed at first to be a *Helix*,) a peculiar little Molmein shell with teeth inside the peristome. I have no hesitation in uniting to this species, besides the closely allied *N. capessens*, Bens., the *Tridopsis*-like *N. pylaica*, Bs, and the present species, as well as the two following. *N. pylaica*, *N. capessens*, *N. infrendens*, and the present species are all distinguished by peculiar additions to the peristome, and form together a well marked group, all being more or less depressly trochiform, horny, with closely wound narrow whorls, arcuately costulate above, and smooth beneath.

N. helicifera was found rarely on the road between Prome and Tongoop, and somewhat further south. In the Bassein district it appears to be replaced by *N. Basseinensis*.

6. N. MAMILLARIS, n. sp.

Shell minutely perforated, very depressly trochiform, suborbicular, thin, horny; finely, closely and arcuately costulated above, the costulations passing over the periphery; smooth, shining, and radiately

striated beneath. Spire depressly conoid, with convex sides, the apex slightly acuminate and papillar; suture but little impressed. Whorls 7½, convex, closely wound, slowly increasing; the last sharply keeled, flatly convex beneath, marked in nearly adult and sometimes in full grown specimens, with two or three small pits of variable form, opaque from corresponding internal calli, and generally arranged in an oblique line opposite to the mouth. Aperture oblique, sub-rhomboidally lunate, 3 times as broad as high; columella furnished in young specimens with a more or less rudimentary spiral lamina running up the whorls, which is obsolete in adult shells. Peristome thin, slightly curved forwards at the base; margins distant, columellar margin very oblique.

	Millem.	inch.
Major diameter,..................	11	0.44
Minor ditto, ...	10	0.4
Axis, ...	6½	0.26

Aperture 5½ millem. broad, scarcely 2 high.

Animal similar to that of *N. helicifera.*

Habitat—Akoutoung, Pegu—not rare.

The close relation of this species to the last is unquestionable; besides resembling it in general form, texture, and sculpture, and in the characters of the animal, young specimens possess a similar columellar fold, and indentations on the lower surface somewhat resembling those of *N. helicifera,* though less deep and more opaque. Both these characters, however, appear to become obsolete in adult specimens of the present form. The two species are easily distinguished by the absence of the columellar lamina in adults of *N. mamillaris,* which may also be recognised by its acuminate apex, lower spire and flatter base.

7. N. Basseinensis, n. sp.

Shell minutely perforated, globosely trochiform, subcampanulate, thin, horny, closely, sharply and arcuately costulated above, the costulations passing over the periphery to the under surface, which is smooth, shining, and radiately striated. Spire obtusely conoid, with convex sides; apex obtuse; suture slightly impressed. Whorls 7, slightly convex, closely wound, slowly increasing; the last not descending, flatly convex beneath, more tumid near the mouth, keeled

at the periphery, the keel vanishing near the mouth. Aperture lunate, oblique, breadth more than double the height; peristome thin, curved forwards at the base; margins distant, columellar oblique.

	Millem.	inch.
Major diameter,..................	11	0.44
Minor ditto, ...	10	0.4
Axis,.........	7½	0.3

Aperture 5½ millem. broad, 2 high.

Habitat—Southern portion of the Arakan range of hills near Bassein and Cape Negrais.

This shell is distinguished from *N. mamillaris* by its non-acuminate apex, higher spire and more convex base, and from *N. helicifera* by the absence of the columellar lamina, of which no trace appears in the present species. It appears to replace the last named shell in the southern portion of the Arakan hills. It is scarce, and I have met with but few specimens in good condition. I have never seen the animal, which, however, is doubtless similar to those of the two preceding species.

Section *Trochomorpha.*

8. N. CONFINIS, n. sp.

Shell minutely perforated, trochiform, very thin, whitish horny, smooth, shining. Spire conical, apex slightly obtuse, suture scarcely impressed. Whorls 7, flatly convex, marked above with 4 or 5 spiral ribs and fine oblique lines of growth; the last sharply keeled, flatly convex beneath, and very finely radiately striated. Aperture oblique, subrhomboidal, twice as broad as high; peristome thin, acute, straight; margins distant, columellar subvertical, briefly and triangularly reflexed.

	Millem.	inch.
Major diameter,..................	10½	0.42
Minor ditto, ...	9½	0.38
Axis,.........	7	0.28

Aperture 5 millem. broad, 2½ high.

Habitat—near Thayet Myo, on the borders of British Burma; also near Ava.

A near ally of *N. arx*, Bens., from Tenasserim, which, however, may easily be recognised by the concave sides of its spire. From other

related species, as *N. infula*, Bens., *N. cacuminifera*, Bens., and *N. attegia*, Bens., *N. confinis* is distinguished by its sculpture.

9. N. CULMEN, n. sp.

Shell very minutely perforated, trochiform, very thin, horny, translucent. Spire conical, apex obtuse, suture impressed. Whorls 6, convex above and ornamented with fine raised spiral lines, and oblique striæ; the last whorl sharply keeled at the periphery, not descending, swollen and minutely decussately striated beneath. Aperture but little oblique, subquadrately lunate; height less than the breadth; peristome simple, thin; margins distant, columellar vertical, slightly reflexed above.

	Millem.	inch.
Major diameter,..................	$5\frac{3}{4}$	0.23
Minor ditto, ...	$5\frac{1}{3}$	0.21
Axis, ...	$5\frac{1}{2}$	0.22

Aperture 3 millem. broad, 2 high.

Habitat—Akoutoung and banks of the Tsanda Khyoung, Henzada district, Pegu.

Easily distinguished from *N. confinis* and *N. attegia* by its smaller size and higher spire; from *N. arx*, by the sides of the spire being straight and not concave, and from the Bengal *N. infula*, Bens., by its sculpture, and its sharper keel.

10. N. GRATULATOR, n. sp.

Shell perforated, turbinate, thin, whitish horny. Spire conical; apex obtuse; suture impressed. Whorls 5, slowly and regularly increasing, convex, spirally lirate and marked with oblique striæ of growth above; the last whorl keeled at the periphery, convex and decussately marked with concentric and radiating striæ below, not excavated around the perforation. Aperture diagonal, subtrapezoidal, breadth exceeding the height; peristome thin; margins distant, united by a callus; basal deeply sinuate; columellar vertical, forming a right angle with the basal, and briefly triangularly reflexed above; reflexed portion thickened and passing half round the perforation.

	Millem.	inch.
Major diameter,..................	5	0.2
Minor ditto, ...	$4\frac{1}{2}$	0.18
Axis, ...	4	0.16

Aperture 3 millem. broad, 2 high.

Animal with a small mucus pore, and very small lobe above.

Habitat—Irawaddy valley, Pegu.

This pretty little species abounds near Thayet Myo, and occurs throughout the Irawaddy valley in British Burmah. I do not remember meeting with it in Arakan. It is easily distinguished from all others of similar form among Indian shells, by its very oblique mouth, by the peculiar columellar margin of the peristome, and by the strong lirate sculpture. I have much doubt as to whether it should be assigned to *Trochomorpha*, the species of which group are larger, and the animals somewhat different.

Section *Kaliella ?*

11. N. CONULA, n. sp.

Shell subperforate, turreted, white, horny, thin, translucent, marked with oblique sinuous subfiliform costulate striation, and, below the centre of the whorl, with very fine spiral lines, only visible under a powerful lens. Spire conical, apex rather obtuse, suture deeply sunk. Whorls 6, very convex, keeled in the centre, the keel very fine, raised, thread-like, opaque and white; the last whorl bicarinate, the second raised spiral line being below the periphery; flatly convex beneath, and marked by radiating striæ and concentric impressed lines. Aperture oblique, tumidly and subangulately lunate, about equally broad and high; peristome thin; margins distant; columellar nearly vertical, very briefly reflexed at the penultimate whorl.

	Millem.	inch.
Diameter, ...	$1\frac{3}{4}$	0.07
Height, ...	2	0.08

Habitat—Phoung ditto. Arakan.

A minute species remarkable for its keeled and convex whorls. Only 4 specimens were found.

GENUS HELIX.

Section *Plectopylis.*

12. H. KARENORUM, n. sp.

Shell sinistrorse, very widely umbilicated, discoid, flat above, solid, white, with rather irregular oblique pale chesnut streaks crossing the whorls, transversely and sinuously striated with decussating spiral

lines above and below; epidermis thin, horny. Apex minutely granulate or sub-granulate, almost imperceptibly raised above the flat spire; suture not impressed, very narrowly marginate. Whorls 6, narrow and closely wound, flat above; the last angulate above the periphery, rounded beneath, descending close to the mouth, very slightly compressed behind the same. Umbilicus very shallow, exposing all the whorls. Aperture, diagonal, truncately subcircular; peristome white, reflexed throughout, margins joined by a raised bar, from the centre of which a lamina passes up the parietal side of the whorl to the plication, which lies at about $\frac{1}{4}$ the circumference of the whorl from the mouth, and resembles that of *Helix achatina*, Gray; the parietal transverse lamina being simple and oblique above, then bifurcating, giving off the lamina which runs to the mouth, and two short basal supports. A thread-like lamina also runs along the extreme base of the parietal side of the whorl, and joins the aperture. Palatal teeth 5; the upper 3 and the lowest longitudinal, the uppermost very long and thin, the 4th vertical, corresponding to the fork in the parietal lamina.

	Millem.	inch.
Major diameter, ...	13	0.52
Minor ditto, ...	11	0.44
Axis, ...	4	0.16

Habitat—Banks of Tsanda Khyoung, near Kaintha village, in Henzada district, Pegu. Larger variety; major diameter 18 millem. minor diameter 15, height 5. A very few specimens were found on the banks of the Nungatho Khyoung, Henzada district.

This shell combines the external form of *H. leiophis*, Bens., and *H. refuga*, Gould, with the internal plication of *H. achatina*, Gray. From both the first named species, however, the present may be easily distinguished by its more perfectly discoid shape, by its smaller height, and more open umbilicus, as well as by its colouring. Externally, it is a very different shell from *H. achatina*, being of not more than half the thickness of that species. The internal plication, however, is absolutely undistinguishable.

Like many other shells in Pegu, this species has evidently a very local distribution. In the spot where it was found first, among some limestone rocks forming a low ridge skirting the right bank of the

Tsanda Khyoung, it was abundant, but it was not met with again until 3 or 4 specimens of the larger variety were found nearly 50 miles further south.

The locality given by Mr. Benson for *Helix leiophis* is Kwadouk near Thayet Myo. The shell also abounds at Akoutoung, on the Irawady, below Prome.

13. H. PERARCTA, n. sp.

Shell sinistral, widely umbilicated, discoid, rather thin, white, transversely sinuously striated, with faintly marked decussating spiral lines above and below. Apex minutely granulate, slightly raised above the flat spire, suture rather deeply impressed. Whorls 6, convex above and at the periphery, the last a little compressed behind the mouth, descending suddenly to the aperture, which is oblique and roundly lunate; peristome white, expanded all round; margins joined by a somewhat curved ridge, from the centre of which a lamella runs up the whorl towards the parietal plication, which, however, it does not join. The parietal vertical lamina is single, simple, rather short, slightly curved, with a rudimentary transverse plait at the top. Two free horizontal lamellæ occur beneath that running to the aperture, the lowest being the longest and thinnest, and running back beneath the base of the vertical lamina. Palatal teeth 6, all horizontal except the 4th and 5th, which are slightly oblique. Umbilicus open, deep, exposing all the whorls.

	Millem.	inch.
Major diameter,..................	11	0.44
Minor ditto, ...	9	0.36
Height, ...	4	0.16

Habitat—Mya Leit Doung, near Ava.

Distinguished from its allies, *H. refuga*, *H. leiophis*, and *H. Kareno-rum*, by its deeper suture and rounded whorls, and internally by the shorter parietal lamina, and by the 5th palatal plait being less oblique than in *leiophis*, and not backed by a second plait as in *refuga*. This species is the smallest known amongst those belonging to the Burmese types of *Plectopylis*.

14. H. FEDDENI, n. sp.

Shell sinistrorse, very widely umbilicated, discoid, flat above, thin, dull white, marked by rather irregular oblique sculpture both above

and below. Spire quite flat, apex not rising above the surface, suture impressed. Whorls $6\frac{1}{2}$—7, narrow and closely wound, slightly convex above; the last much broader, rounded at the periphery and beneath, descending abruptly close to the mouth. Umbilicus shallow, exposing all the whorls. Aperture more nearly horizontal than vertical, subcircularly lunate. Peristome slightly thickened, expanded throughout, margins joined by a rib, from the centre of which a lamina sometimes runs up to the parietal plication, but is frequently interrupted a short distance within the aperture, and is always thicker and higher near the mouth than further back. Parietal plication consisting of a vertical lamina in front, and a second, slightly oblique, just behind the first, giving out the interrupted lamina running to the aperture from the top, and a shorter horizontal lamella from the bottom; the hinder with small re-entering supports above and below. Beneath both is a narrow free thread-like horizontal lamella. Palatal teeth 5: 1st, 2nd, 3rd and 5th horizontal, 4th vertical and stouter than the others; 1st and 2nd longer than the remainder.

	Millem.	inch.
Major diameter,....................	16	0.65
Minor ditto, ...	13	0.52
Height,..........................	$4\frac{1}{2}$	0.18

Habitat.—Prome: rare.

Of this unquestionably distinct species but 3 or 4 specimens were found by Mr. Fedden and myself. Both the external form and plication differ from those of all allied species. It is especially distinguished by its rounded periphery, wider last whorl, and its irregular non-decussated sculpture externally, and internally by the double parietal lamina.

Section?

15. H. POLYPLEURIS, n. sp.

Shell openly umbilicated, trochiform, rather solid, white, (probably horny in living specimens,) obliquely and closely costulated. Spire conoid; apex rather obtuse; suture impressed. Whorls 6, convex, slowly increasing; the last not descending, surrounded by a raised thread-like keel, convex beneath, and somewhat sinuously radiately costulated around the deep and pervious umbilicus. Aperture oblique,

roundly lunate, almost circular; peristome thin; margins distant, columellar slightly expanded.

	Millem.	inch.
Major diameter,.................	4	0.16
Minor ditto, ...	$3\frac{3}{4}$	0.15
Axis,................................	3	0.12

Habitat—Arakan hills: rare.

A prettily marked little species near *H. Bascauda*, Bens., from which it is distinguished by its finer and closer sculpture, more open umbilicus, and less conical spire. It is very probably a *Nanina*, but the animal was not met with.

Genus BULIMUS.

16. B. scrobiculatus, n. sp.

Shell subobtectly perforated, turritedly ovate, thin, horny, yellowish white, marked with vertical, subarcuate, rather irregular, closely set, raised lines. Spire turrited, apex obtuse, suture simple, impressed. Whorls 6, convex, the last rounded beneath. Aperture vertical, truncately ovate: peristome simple, thin; right margin considerably curved forwards; columellar vertical, curving to the left near the base, frequently straight, rather broadly reflexed.

	Millem.	inch.
Length, ...	7	0.28
Diameter, ...	$3\frac{1}{2}$	0.14
Length of aperture, ...	$3\frac{1}{2}$	0.14

Habitat—Pegu, west of the Irawady.

The nearest ally of this species is its congener *B. putus*, Bens., which inhabits the same localities, and differs in its greater tumidity and less marked sculpture. There is, however, much variation in the first named character, and despite the great difference between the two forms in general, there is some appearance of a passage. Two specimens of *B. putus* which I possess, measuring respectively 7 and $8\frac{1}{2}$ millem. in length, are both 5 millem. in diameter.

Both these species shew a tendency to a passage to *Spiraxis*.

17. B. plicifer, n. sp.

Shell obtectly perforated, ovately conical, rather thin, horny, finely striated. Spire conical, apex obtuse; suture marginate, scarcely

impressed. Whorls 5, planulately convex above, the last longer than the spire, somewhat tumid, rounded at the base. Aperture vertical, truncately oval, subpyriform; peristome simple; right margin curved forwards; columellar callous, subvertical, slightly curved, rather broadly reflexed; margins united by a callus bearing a small re-entering lamella about the centre.

	Millem.	inch.
Length, ...	9	0.36
Diameter, ...	$5\frac{1}{2}$	0.22

Aperture 5 millem. high, $2\frac{1}{2}$ broad.

Habitat—Thayet Myo, Pegu: rare.

A more tumid shell than *B. putus*, Bens., and easily distinguished from all other Indian and Burmese forms of the genus by the re-entering parietal plait.

Genus SPIRAXIS.

18. S. pusilla, n. sp.

Shell imperforate, ovate, thin, horny, yellowish white, costulately striated. Spire conically pyramidal; sides straight; apex rather acute; suture impressed. Whorls 5, convex; the last longer than the spire (ratio = 4 : 3) and rounded beneath. Aperture rather oblique, subpyriform; peristome simple, acute, much curved forwards on the right margin; columella scarcely twisted, reflexed, appressed on the whorl.

	Millem.	inch.
Length, ...	6	0.24
Diameter, ...	$3\frac{1}{2}$	0.14
Length of aperture, ...	$3\frac{1}{2}$	0.14

Habitat—Prome district, Pegu: rare.

I am not quite sure if all of the few specimens I possess of this peculiar small form came from Akoutoung, or whether some may not be from Thayet Myo. The shell resembles young specimens of *Bulimus putus*, Bens., so closely, that it can only be distinguished by the absence of any perforation.

Genus ACHATINA.

19. A. Peguensis, n. sp.

Shell oblong ovate, rather solid, dark reddish brown, horny, marked with distinct and regular impressed lines. Spire convexly conical;

apex obtuse; suture impressed, subcrenulate. Whorls $6\frac{1}{2}$, slightly convex; the last ascending a little towards the mouth, and exceeding $\frac{1}{3}$ of the shell in length. Aperture vertical, truncately semicircular; peristome obtuse, slightly thickened; margins joined by a callus; columella very much curved, projecting forwards at the base, subvertically truncated within the peristome.

	Millem.	inch.
Length, ...	7	0.28
Diameter, ...	$3\frac{1}{2}$	0.14
Length of aperture, ...	$2\frac{3}{4}$	0.11

Habitat—Irawady valley, Pegu: common.

A pretty little species, darker in colour than any of its allies, except perhaps *A. gemma*, Bens., and easily distinguished from all, by the columella being more arcuate, also by its more acuminate spire and blunter apex, and its much stronger sculpture.

20. A. PERTENUIS, n. sp.

Shell very slender, turrited, thin, light horny, polished, closely, minutely, and rather irregularly striated. Spire subulate, somewhat acuminate towards the blunt apex; suture impressed, subcrenulate. Whorls 11—12, convex, the last about $\frac{1}{5}$ the length of the spire. Aperture oblique, ovately pyriform, peristome thin, margins united by a thin callus, columella moderately curved, obliquely truncated.

	Millem.	inch.
Length, ...	20	0.8
Diameter, ...	$4\frac{1}{2}$	0.18
Length of aperture, ...	4	0.16

Habitat—Tongoop, Arakan.

Var major, length $26\frac{1}{2}$ millem.; diameter 6; length of aperture 6. Of another specimen; length 23 millem.; diameter $5\frac{3}{8}$; length of aperture $5\frac{1}{4}$.

Habitat—Pyema Khyoung, Bassein district, Pegu.

A much more slender species than *A. tenuispira*, Bens., (a variety of which also abounds in parts of Pegu,) though there are signs of a passage. The present appears to replace *A. tenuispira* in Arakan and Bassein. Mr. Benson, to whom I sent a specimen, observes that it is intermediate between *A. tenuispira* and *A. hastula*, Bens.

Genus SUCCINEA.

21. S. plicata, n. sp.

Shell depressly subovate, very thin, irregularly, obliquely and more or less coarsely plaited, pale amber in colour, horny. Spire short; apex minutely papillar? Whorls $2\frac{1}{2}$; the last about $\frac{4}{5}$ of the entire length. Aperture oblique, curved backwards at the base, nearly oval, openly angulate above; peristome simple; columellar margin regularly bow-shaped; right margin rather straighter.

	Millem.	inch.
Length, ...	17	0.68
Diameter, ...	$9\frac{1}{2}$	0.38

Height, when laid upon the mouth, 6 millem. Aperture 14 millem. long, 8 broad.

Habitat—Tongoop, Arakan: one or two specimens, rather less coarsely sculptured, occurred also south of Bassein in Pegu.

This species approaches *S. semiserica*, Gould, but is distinguished from that and from all other Indian species by its coarse sculpture. It has also a larger spire than *S. semiserica*. It is not common: indeed species of the genus *Succinea* are generally but very locally distributed in India and Burma.

Genus CLAUSILIA.

22. C. fusiformis, n. sp.

Shell not rimate, fusiform, horny, thin, white; obliquely, very closely and finely costulately striated throughout. Spire diminishing slowly at first above the middle, then rapidly attenuate towards the acute apex; suture simple, scarcely impressed, deeper towards the apex. Whorls 9, convex above, flattened below, the last very little narrower than the penultimate. Aperture semioval, (nearly semicircular); upper parietal plait very fine; internal palatal teeth 7, the uppermost by far the longest. Peristome thin, expanded, not continuous, the margins being distant, and united by a thin callus; columellar margin straight and very long posteriorly.

	Millem.	inch.
Length, ...	23	0.92
Diameter, ...	6	0.24

Habitat—Arakan hills, west of Henzada. Very rare.

But a solitary specimen was met with belonging to this form, which is more tumid in the centre than any of its allies, *C. insignis*, Gould, &c. The non-continuity of the peristome may be due to immaturity in the specimen found. The shape of the mouth may also possibly be slightly modified in older examples, but the general form doubtless remains the same, and is alone sufficient to distinguish the species.

A solitary specimen of another new form, much smaller than the above, being only 17 millem. long, occurred at Moditoung Tsekan, on the road from Prome to Tongoop. It is unfortunately bleached and worn, though perfect.

Genus STREPTAXIS.

23. S. Burmanica, n. sp.

Shell ovately subglobose, umbilicated, thin, horny, white, marked throughout with fine and closely set sinuate costulation. Spire convex; sutures scarcely impressed. Whorls 6, the last 2 widely excentric, rounded at the periphery; the penultimate broader than the last whorl; last flattened beneath, and angulately compressed around the umbilicus. Aperture oblique, irregularly semioval, with a single re-entering lamellar parietal; peristome white, thin, expanded throughout, deeply sinuate above, at the junction with the penultimate whorl, compressed and curved forwards on the upper right margin, and sometimes furnished with a very small internal tooth-like callous projection; the two margins subparallel, distant, united by a thin callus.

	Millem.	inch.
Major diameter,......	10	0.4
Minor ditto, ...	7	0.28
Height,.........	6	0.24

Habitat—Tongoop, Arakan.

This is a very near ally of the Molmein *S. Petiti*, Gould, but it is distinguished from that shell and from *S. exacuta*, Gould, by the rounded periphery and more globose form. It is larger and less slender than *S. Andamanica*, Bens., and is distinguished from all the above species, and also from the Nilgiri *S. Perrotteti*, by the greater size of the penultimate whorl in comparison with that of the antepenultimate, a character to which my attention was called by Mr. Benson.

In Dr. Gould's original description (an imperfect one) of *S. Petiti*,

as republished in Otia Conchologica, p. 183, no mention is made of the angulation of the periphery, which, however, is referred to by Pfeiffer, (Mon. Helic. I. 8). The character is certainly variable: in specimens in my own collection there is a considerable difference.

Order,—PROSOBRANCHIATA.

Family *Cyclophoridæ.*

Genus CYCLOPHORUS.

24. C. (*Lagocheilus*) leporinus.

Shell narrowly umbilicated, conically turbinate, thin, dark horny, and ornamented throughout with oblique striæ and with raised spiral lines, closer together at the periphery and within the umbilicus than elsewhere. Spire conical; apex rather acute. Whorls $5\frac{1}{2}$, rounded; the last cylindrical, not descending. Aperture oblique, subcircular, angulate above; peristome simple, thickened, subexpanded, incised at the upper angle; columellar margin curved backwards. Operculum horny, greyish white, multispiral.

	Millem.	inch.
Major diameter, ...	4	0.16
Minor ditto, ...	$3\frac{1}{2}$	0.14
Axis, ...	4	0.16

Habitat—Akoutoung, Pegu.

This form is allied to *Cyclophorus scissimargo*, Bens., and *C. tomotrema*, Bens., forming with them the group for which Mr. Theobald has proposed the name of *Lagocheilus.* There appears good reason for associating these shells as a distinct subgenus, which perhaps represents, in Burma, the group of *Cyclophori* comprising *C. halophilus* and its allies in Southern India and Ceylon. The present species is smaller and higher in the spire than either of the others. The animal of *C. leporinus* is short, dark in colour, with small black tentacles, and resembles ordinary *Cyclophori* in most characters. The only specimen obtained living and examined, possessed, however, the peculiarity of a groove down the middle of the caudal portion of the foot above.

The peristome is simple in the only perfect adult specimen which I possess, but in a broken barely adult shell, there is a rudimentary duplication. The two lips are probably united in the full grown shell.

I also met with a shell apparently belonging to this species, but not full grown, at Pyema Khyoung, south of Bassein.

An immature specimen of probably a 4th species of *Lagocheilus*, with very fine and rather close equidistant spiral sculpture, was found by me in the neighbourhood of Ava.

GENUS PTEROCYCLOS.

25. PT. FEDDENI, n. sp.

Shell widely umbilicated, convexly depressed, smooth, finely striated rather thin, elegantly marked with alternating transverse zigzag stripes of white and chesnut, and with a moderately broad submedian band of darker colour. Spire nearly flat; apex but very slightly protruded; suture deep. Whorls $4\frac{1}{2}$, convex; the last rounded, descending towards the mouth. Aperture circular, slightly oblique; peristome double; the two portions separated by a shallow groove, the inner cut away into a moderate sinus above, and the outer turned up into a small vertical wing, free from the penultimate whorl. Operculum concave within, the centre flat; flatly concave without, with lamellar free edges to the whorls, thickest at the circumference.

	Millem.	inch.
Major diameter,..................	11	0.44
Minor ditto, ...	9	0.36
Axis, ...	5	0.2

Habitat--Thayet Myo, Pegu—rare.

A smaller and more convex shell than *Pt. cetra*, Bens. from Molmein. It is one of the most beautifully marked species of the genus; it resembles *Pt. pullatus*, Bens., in form, and in the peculiar characters of the operculum, and equals the handsomest specimens of *Pt. rupestris*, Bens., in its colouring.

Named after the discoverer, Mr. Fedden, of the Geological Survey.

GENUS ALYCÆUS.

26. A. POLITUS, n. sp.

Shell moderately umbilicated, turbinately depressed, smooth, polished, shining, amber-coloured. Spire depressly conoidal; suture deep; apex obtuse, rather redder than the remainder of the shell. Whorls $3\frac{1}{2}$, convex; the last round, scarcely descending towards the mouth, very little swollen at the side, and ornamented on the inflated portion

for a short distance with close fine costulation, which extends beneath to the umbilicus and renders the shell opaque in that spot. Constriction long, smooth, swelling considerably in front towards the mouth. Sutural tube short, about $\frac{1}{5}$ to $\frac{1}{6}$ of the periphery of the penultimate whorl. Aperture oblique, circular, deeply sinuate at the junction with the penultimate whorl, and at the lower right margin; peristome double, the inner lip projecting and continuous, outer lip retrorelict. Operculum horny, multispiral, externally concave.

	Millem.	inch.
Major diameter,.................	3	0.12
Minor ditto, ...	$2\frac{1}{4}$	0.09
Axis, ...	$1\frac{1}{4}$	0.05

Habitat—Phoung do, near Cape Negrais, Arakan.

Very near *A. humilis*, W. Blanf., from Pegu, but distinguished by its lower spire, wider umbilicus, more sinuous mouth, and especially by its high polish, in which it is only equalled by *A. nitidus*, W. Blanf.

27. A. GLABER, n. sp.

Shell broadly umbilicated, conoidly depressed, solid, reddish white, the upper whorls darker, rather dull in lustre, smooth, except at the swollen portion of the last whorl, which is very finely and closely costulated. Spire depressly conoid; apex rather obtuse; suture impressed. Whorls 4, convex, the last obsoletely subangulate at the periphery, moderately swollen at the side, then constricted, descending a little near the mouth. Constriction of moderate length, smooth, slightly swollen in the middle. Sutural tube of moderate length. Aperture diagonal, circular; peristome more or less distinctly duplex, thickened, moderately expanded. Operculum dark coloured, horny, externally concave, internally convex, with a prominent central nucleus.

	Millem.	inch.
Major diameter,.................	$7\frac{1}{2}$	0.30
Minor ditto, ...	6	0.24
Axis, ...	$4\frac{1}{2}$	0.18

Habitat—Akyab, Arakan; the hills south of the harbour.

This species closely resembles *A. Ingrami*, W. Blanf., for which I for some time mistook it, but it is distinguished by the absence of any sculpture on the upper whorls, and also by the more oblique mouth.

Genus DIPLOMMATINA.

28. D. nana, n. sp.

Shell not rimate, dextrorse, subovate, rather solid, amber-coloured, very finely and closely filiformly costulated on the lower whorls, less closely on the upper, or, frequently, subdistantly costulated throughout. Spire conical, with sides scarcely convex above; apex rather obtuse, sometimes reddish, suture impressed. Whorls 6—6½, rounded, antepenultimate the largest, the last rising considerably upon the penultimate. Aperture vertical, ear-shaped, nearly circular, columellar margin straight for a short distance and vertical, with an internal tooth. Peristome double, both portions expanded and appressed, the inner forming a thin callus upon the penultimate whorl. Operculum ?

	Millem.	inch.
Length, ...	2¼	0.09
Diameter, ...	1	0.04

Aperture with peristome about ⅝ millem. in diameter.

Habitat—Akoutoung, Thondoung and Yenandoung in Henzada district, Pegu.

This species approaches *D. polypleuris*, Bens., more nearly than any other. It is distinguished by its more regularly ovate form, blunter apex, less swollen penultimate whorl, and more marked and distant sculpture. The latter character, however, varies. The specimens from Thondoung, a hill about 20 miles south of Akoutoung, being either closely costulate throughout, or subdistantly sculptured above, closely below; while in Akoutoung specimens, the costulation is subdistant throughout. As, however, I can trace no other distinction between the shells, and the costulation varies in different individuals from each place, I do not think there is any specific distinction.

A still more minute species than the present exists in Pegu, and I found two dead specimens at the base of the Arakan hills in the Henzada district. As these specimens were not very well preserved, I abstain from describing them for the present.

Family *Helicinidæ*.

Genus HELICINA.

29. H. Arakanensis.

Shell depressly turbinate, sublenticular, rather thin, obliquely striated above, radiately and very minutely beneath, polished, flesh-coloured,

with a darker red band in the centre of the whorls above, and another on the last whorl, just below the periphery; apex yellow. Spire convexly conoid; apex acute. Whorls 4, the last compressed and sharply keeled, moderately convex at the base, furnished with a polished subgranulate central callus; columella very short. Aperture diagonal, triangular; peristome white, slightly expanded. Operculum light grey, shelly.

	Millem.	inch.
Major diameter, ...	6	0.24
Minor, ...	5	0.2
Axis, ...	$3\frac{1}{2}$	0.15

Habitat—Ramri Island, coast of Arakan. Rare.

A smaller variety, measuring—major diameter 5, minor $4\frac{1}{4}$, axis 3 millem., was abundant in the southern portion of the Bassein district.

Near *H. Merguiensis*, Pfr. and *H. Andamanica*, Bens., but smaller than either. It is mainly distinguished from the former by the absence of the close spiral striation, so marked in that species, and from the latter by different colouring, higher spire and closer sculpture.

The preceding pages contain descriptions of the greater portion of the previously unpublished species of land shells in my collections from Ava, Pegu, and Arakan; I have still a few remaining, the distinctness of which is probable, but they belong, for the most part, to critical groups, and require comparison with the original types of species, described by Mr. Benson and others. The following additional notes, on the distribution of previously described species, may serve to supplement the papers on the subject, by Mr. Theobald, in Jour. As. Soc. Bengal, Vol. XXVI. p. 245, and Vol. XXVII. p. 313.

Nanina.

Nanina petasus, Bens., is common about Thayet Myo and in the Arakan hills. My largest specimen measures 12 millemetres by 11 in its two diameters. A smaller, closely allied shell, measuring 8 by 7 millem., I was inclined to refer to Mr. Benson's *Helix aspides*, on account of the arcuate and labiate basal margin of the aperture, but I learn from the describer that it presents differences, although not sufficient to prove it a distinct species. A third still smaller form, with the thickening and curvature of the peristome exaggerated, and

a somewhat flatter spire, measures only 5 to 5¼ millem. in its largest diameter, and may be a distinct shell. It, also, is from the Arakan hills.

Nanina honesta, Gould, originally described from Tavoy, is found throughout western Pegu and Arakan, as well as at Molmein, where it was collected by Mr. Theobald. Dr. Gould's description is very imperfect; he does not even note the great obliquity of the mouth, which is the most striking character of the species. In the Arakan hills near Prome, and about Thayet Myo, a larger variety occurs, in which the angulation of the periphery entirely disappears in the adult, although the other characters are the same. The sutural margination is sometimes, though rarely, obsolete. Large specimens measure 14 by 11½ millem., and about 7 in height.

N. levicula, Bens., also first found by Mr. Theobald in the Tenasserim provinces, is very common about Thayet Myo, Prome, and Akoutoung, and occurs also as far south as the Bassein district. It is frequently whitish in colour. It is allied to *N. honesta*, but easily distinguished, besides by its smaller size, by the fewer whorls and their more rapid rate of increase, and also by the total absence of sculpture. There is much variation in size: my largest specimen measures 8½ and 7 millem. in its two diameters. The animal has a very small lobe above the mucus pore in the tail, which is truncated. The mantle is rather large. A single specimen of a shell, apparently identical, was found by me, some years ago, near Balasore in Orissa.

N. textrina was evidently described by Mr. Benson, (in the Annals and Mag. Nat. Hist. 1856, Ser. 2, Vol. XVIII. p. 252,) from an immature specimen. When adult, the peristome is white and slightly thickened within, and the body whorl internally of a milky white colour. This handsome species is found west of the Irawady, from Thayet Myo to Bassein, and varies considerably in size, in the height of the spire, and in the degree of angulation above the periphery. The greatest change takes place in the latter character; specimens from the district of Bassein being sharply angled, and even subcarinate, the angulation diminishing, however, close to the aperture; while, in specimens from Thayet Myo and Prome, the periphery is round. In height of spire, the shell varies from depressed to subturbinate; in two specimens before me, one has a major diameter of 30 millem., and height of 13; the other with a major diameter of only 27, measures

15 millem. in the axis, and this variation is seen in both rounded and subcarinate specimens. The largest specimen I possess, measures in its two diameters, 36 and 31 millemetres, and in height 18.

N. pansa, Bens., was found near Akoutoung and Thayet Myo; and also, more abundantly, in the neighbourhood of Ava.

N. (*Trochomorpha*) *attegia*, Bens., abounds at Akoutoung below Prome. It is not common elsewhere, except about Prome. The animal has a mucus pore at the end of a truncated foot, and a lobe above, as in *N. vitrinoides*, Desh. A shell which Mr. Benson considers as probably identical with *Helix diplodon*, Bens., (a Khasi hill species) occurs rarely in the Arakan hills. It is a *Nanina* with a small lobe above the mucus pore near the end of the tail, which, however, is more flattened and less truncated than in species of the *Trochomorpha* section generally.

No species of the *Ariophanta* section, so largely represented in India, has as yet been found in Pegu or Arakan;* *N. retrorsa*, Gould, being hitherto unknown N. or W. of Molmein. *Macrochlamys* and *Trochomorpha* (unless *N. textrina* and *N. pansa* belong rather to *Hemiplecta* than to the former,) comprise the great majority of the *Naninæ*. The forms belonging to the first named section are so numerous, and distinguished by such minute differences, that their study is one of great difficulty.

Helix.

Amongst the true *Helices* in Northern Pegu, several forms assigned to the section *Dorcasia*, Gray, are conspicuous. They appear to represent in Burma, *H. fallaciosa*, Fèr., *H. asperella*, Pfr., and their allies of the Indian peninsula, and they might all perhaps with greater correctness be classed together in the same section. Amongst these forms is *H. similaris*, Fèr., of which *H. scalpturita*, Bens., and *H. Zoroaster*, Theobald, appear to be varieties. These shells occur in the drier portions of the Irawady valley, and are not found below Prome, but they extend northwards to beyond Ava. The variety named by Mr. Benson *H. scalpturita* sometimes wants the coloured

* Nor is this section, so far as I know, represented in the Himalayas. *N. Himalayana*, Lea, being almost certainly *N. interrupta*, Bens., and the assigned locality due to an error; while *H. cyclotrema*, Bens., lately described from the hills N. of Tirhoot, is a sinistrorse member of the *asperella* group, and closely allied to that species, as may be seen from its expanded lip and granulate surface. The animal is doubtless a true *Helix*, and not a *Nanina*.

bands, and passes into a shell closely resembling *H. Peguensis*, Bens., a more solid form, shells approaching which closely in every character except in being less solid, were found on the Shan hills, east of Ava. Mr. Benson considers these shells distinct from *H. Peguensis*, but there can be little doubt of their forming a link. The typical variety of *H. scalpturita* abounds near Mandélé. *H. Zoroaster*, Theobald, is a large *H. similaris*, and occurs abundantly at Thayet Myo and less so at Prome. *H. bolus*, Bens., abundant near Thayet Myo and Prome, is sometimes marked by a coloured band like that of *H. similaris*, and varies greatly in the height of the spire. The type is a well marked form, far more globose than the others, but yet it passes, by imperceptible gradations, into *similaris*. *H. delibrata*, Bens. is also allied to *similaris* although classed in a different section or subgenus by both Albers and Pfeiffer; it unites *Dorcasia* with the *Trachea* group, (*H. asperella* and its allies). *H. delibrata* is not rare throughout Arakan; it occurs at Akyab, and in Pegu it is found at Akoutoung and other places; when fresh it has a subhispid epidermis, and frequently a rufous band above the periphery, like *similaris* and *asperella*.

Somewhat allied to the *similaris* group, but yet forming a distinct and well marked section, are *H. tapeina*, Bens., and its allies *H. rotatoria*, v. d. Busch, *H. Oldhami*, Bens., and *H. Huttoni*, Pfr. To these, two other species have been added by Mr. Theobald, viz.: *H. Phayrei* and *H. Akoutongensis*. The type appears almost peculiar to the Malay countries, one species only, *H. Huttoni*, occurring upon the Himalayas and other Indian mountains, and none in the plains of India.

H. Oldhami, Bens. is a well marked and easily distinguished form, with almost flat spire, very wide umbilicus, and the last whorl subangulate above the periphery and swollen beneath. The epidermis, when in good order, is subhispid, as in several other species of the group. This form was first found by Dr. Oldham at Mya Leit Doung, a few miles south-east of Ava, and I afterwards met with it in the Arakan hills, on the road between Prome and Tongoop.

The other species pass into each other in the most perplexing manner, and there scarcely appears any choice between increasing their number indefinitely, and classing all together as varieties of one species.

The little form known as *H. Huttoni*, Pfr., is perhaps more easily distinguished than most of the others, as it is singularly constant in

form. It is usually smaller than *tapeina* or *rotatoria*, and may generally be recognised by its blunt periphery and the convexity both of the spire and base. Still, forms of *H. tapeina* approach it so closely that they may be said to pass into it. I found specimens of *H. Huttoni* in only one spot in Burma, viz. on Puppa hill, an isolated peak, nearly 5,000 feet high, in Upper Burma. The occurrence of a Himalayan shell which is found as high as 6,000 and 7,000 feet in Sikkim, upon this solitary hill, where it is accompanied by peculiar species, as *Alycæus Vulcani*, W. Blanf. and *Diplommatina Puppensis*, W. Blanf., and with a flora comprising plants, such as *Pteris aquilina*, belonging to a temperate climate, is very remarkable; especially as the same species was found by myself on the Nilgiri hills of Southern India, at an elevation of above 6,000 feet, and by Mr. F. Layard on the mountains of Ceylon. It is found both in the eastern and western Hima layas, and has probably once enjoyed a far more general range in India than at present. Its occurrence, with so little variation, in isolated situations, is in favour of its being a distinct and natural species, a rank to which, morphologically considered, its claims are small.

At Mya Leit Doung, the high limestone peak 15 miles south-east of Amarapoora, already referred to, and the locality whence *Cyclophorus cryptomphalus*, Bens., *C. hispidulus*, W. Blanf., *Diplommatina exilis*, W. Blanf., *Georissa frustrillum*, Bens. sp., *Hypselostoma Bensonianum*, W. Blanf., *Helix perarcta*, W. Blanf., and other peculiar species have been obtained, I found Mr. Theobald's *Helix Phayrei*, which appears to have some claims to be considered a distinct species. Mr. Theobald's description (J. A. S. B., 1859, Vol. XXVIII. p. 306) is very imperfect, and the following may serve to give a better idea of the shell.

H. Phayrei, Theobald.

Shell moderately umbilicated, orbiculately conoid, rather solid, white, with a horny shining epidermis; obliquely, coarsely and flexuously plicately striated beneath the epidermis, bluntly angulate at the periphery. Spire depressly conoid; apex obtuse; suture scarcely impressed. Whorls 6, slightly convex, slowly increasing; the last descending towards the aperture, where the angulation of the periphery dies out; convex beneath, compressed around the deep umbilicus, which exposes all the whorls. Aperture subcircularly lunate, diagonal; peristome white, slightly expanded throughout; margins

approaching each other, and united by a callus. Major diameter 18, minor $15\frac{1}{2}$, axis 8 millemetres.

Habitat—Mya Leit Doung. Ava.

This differs from all allied forms in its much coarser flexuous sculpture, and from most of them by its blunt angulation at the periphery. It is also, so far as I know, the largest form, belonging to this group, which occurs in Burma.*

H. tapeina is said by Mr. Benson to be distinguished from *rotatoria*, amongst other characters, by the greater regularity of the sculpture in the former shell, which contrasts with the irregularly flexuous striation of the latter.† I have never seen a typical specimen of *H. rotatoria*, which was originally described from Java, but Mr. Benson has identified with it a shell which abounds at Thayet Myo, Prome and Akoutoung, and a variety of which, with a flat spire, Mr. Theobald has called *H. Akoutongensis*. Of *H. tapeina* I possess specimens collected by Mr. Theobald at the original locality, the Khasi hills. These have a slightly more regular sculpture, an angulate periphery instead of the sharp compressed keel of the Pegu form, and a rounder mouth, but the spire is sometimes higher, sometimes not, and I can see no distinction in the umbilicus. In all the distinctive characters, varieties shewing gradation, occur in Burma.

Leaving the question of specific distinction, the distribution of varieties of these shells in the Irawady valley, so far as I have searched, is the following.

On the Shan hills, east of the valley in which lie Mandélé, the present capital of Ava, and the older capitals, Amarapoora and Ava itself, I found a lenticular sharply keeled form, less swollen beneath, and, in general, higher in the spire than the Akoutoung form of *rotatoria*, with the sides of the spire straight, not convex. The epidermis, when in good order, and especially in young specimens, is hispid ; the sculpture rather variable, but flexuous. This latter is also the case with the Akoutoung and Thayet Myo form of *rotatoria*.

* In a letter received since the above was written, Mr. Benson informs me that *H. Phayrei* only differs from his *type* of *H. tapeina* in its coarser sculpture. My specimens of the latter shell have a more angulate periphery.

† In Pfeiffer's Monogr. Helic. Viv., however, *H. tapeina* (Vol. III. p. 254) is said to be "Subtiliter granulato-striata," while *H. rotatoria* (Vol. I. p. 203) is described simply as "oblique striata." The former is said to differ from the latter in sculpture, higher spire, narrower umbilicus and rounder aperture.

In the Tsagain hills, west of the Irawady, opposite Ava, I obtained two forms, one bluntly angled at the periphery and approaching *H. Oldhami*, in which however the spire is lower and the umbilicus more open. The sculpture, form of the whorls and of the mouth, (which is rounded with connivent margins and expanded throughout,) and the angulation of the periphery, are precisely similar to the same characters in my specimens of *H. tapeina*: the umbilicus is slightly broader, and the spire lower, sometimes as flat as in *Akoutongensis*. The dimensions are 15½ and 14 millem. in the two diameters; height 6. The other form is extremely sharply keeled and lenticular, with an angulate lunate mouth, and a narrower umbilicus than the last, or even than the Cherra *tapeina*, but it has the same simple sculpture, differing in this from the Shan hills form, which it otherwise resembles. It measures 17½ millem. by 16, and 9 in height.

The next locality to the south in the Irawady valley at which I obtained forms of this type was at Thayet Myo. I have already referred to the variety prevailing there, as well as at Prome and Akoutoung. As a rule, the shells are small, thin, horny, and more or less hispid, very variable in the height of the spire, sharply keeled and with very fine, flexous striation. The major diameter is about 10 to 12 millem. on an average.

At Henzada, and in its neighbourhood, another form prevails. It is also met with at Akoutoung, but is rare, and it passes into the flatter form there prevailing. The Henzada shell has a much higher spire with very convex sides, and is, in fact, subcampanulate, the base, on the other hand, being flattened. It is sharply keeled, quite as sharply as the Akoutoung form, but it has the sculpture rather of *H. tapeina* than of *rotatoria*, and the epidermis, instead of being subhispid as in the latter shell, is merely granulate. A form, intermediate both in height of spire and in sculpture between the Henzada and Akoutoung varieties, was found in the Arakan hills, between Prome and Tongoop.

In the Bassein district, all the shells of this type are much the same. They have a sharp keel, moderate spire with convex sides, obtuse apex, and but little convexity beneath. They possess a granulate epidermis and the sculpture of *H. tapeina*.

The specimens with the highest spires, from Henzada, approximate

in form to the Cambodia *H. repanda*, Pfr., and may perhaps be identical.

It will be seen how variable the forms are. The spire varies from flat to almost bell-shaped, the periphery from sharply keeled to angulate, the whorls from subconvex to flat or nearly so; nor is there greater constancy in the form of the mouth, the sculpture, the epidermis, or the breadth of the umbilicus. Distinct as many of the varieties appear to be, they all pass gradually into each other, and with the exceptions already described, I believe all the forms are most safely classed as varieties of one species. Whether this should be called *rotatoria* or *tapeina* is difficult to say, without more precise acquaintance with the types of those shells.*

Not far from the *tapeina* group must be classed *H. castra*, Bens., which, despite its thin horny shell and sharp peristome, is not a *Nanina*, but a true *Helix*. It occurs throughout the Arakan hills, wherever I have searched, but is everywhere scarce. It has the widest range in the Indian area of any known *Helix*, being found in the Himalayas, in Orissa, in Ceylon, and throughout Burma as far south as the Tenasserim provinces.

H. climacterica, Bens. is very probably a *Nanina*, but I have not had an opportunity of observing the animal. The shell was found by Captain Ingram on the road from Prome to Tongoop, and I found it again in the hills, at the southern extremity of the Henzada district, and in Bassein. It occurred also in Long island, in the Bassein river. It is much smaller in general than the typical Khasi hill shell; I possess specimens, apparently fully grown, but measuring only 13 or 14 millemetres in their major diameter.

H. hariola, Bens. is a true *Helix*, and is found chiefly on trees near Thayet Myo and Prome. It is a rare shell. Near Ava it is replaced by a large sharply carinate form, which I found abundant at Thingadan, on the Irawady, about 80 miles north of Mandélé. This shell so closely resembles *H. capitium*, Bens., that I am much disposed to consider them identical, a view in which Mr. Benson, however, does not agree. At Puppa hill, near Pagan, already referred to as the

* Mr. Benson, to whom I sent specimens, considers all the forms above mentioned to be varieties of *rotatoria*, but some, especially that from the Tsagain hills, appear to me to be at least as nearly allied to *tapeina*.

locality where *H. Huttoni*, Pfr., is found, I met with an intermediate variety, between the carinate form and the typical *H. hariola*.

The *Plectopylis* group is represented near Ava by *H. perarcta*, described above, and further south by *H. leiophis*, Bens. This shell occurs near Thayet Myo, but I found it abundantly only at Akoutoung. Another form, which may be a small variety of *leiophis*, but which shews some differences in the internal plication, also occurs near Thayet Myo. At Prome, close to the Pagoda, I found *H. Feddeni*, (described above) which, however, appeared very rare, as I only obtained two perfect specimens, despite much search. 20 or 30 miles south of Akoutoung, I found *H. Karenorum* in abundance, and 2 or 3 specimens of the large variety of the same shell still further south in the Arakan hills, nearly due west of Henzada. Elsewhere in the Henzada district and throughout Bassein, no species of the Burmese form of *Plectopylis* was met with, but the Himalayan and Khasi *H. plectostoma*, Bens. abounded south of the town of Bassein in several places, Pyema Khyoung, Long Island, &c. It was also found by Captain Ingram in Arakan, near Tongoop.

Bulimus.

A variety of the sinistrorse *Bulimus Sinensis*, Bens., measuring 26 millem. in length and 15 in diameter, occurs near Prome. It has generally two dark stripes round the body whorl, but some specimens have other stripes, usually 3, above the periphery. Occasional specimens were met with further south. At Tongoop in Arakan, I found a much smaller variety, measuring only 20 millem. in length, and $12\frac{1}{2}$ in diameter. At Akyab I also found this small variety; some shells being entirely yellow without any stripes, like Mr. Theobald's Mergui specimens.

B. putus, Bens. is rather common at Akoutoung, less so at Thayet Myo, and scarce to the south: I found it, however, occasionally, in the Bassein district.

B. pullus, Gray, occurs near Ava; but not, so far as I am aware, in Pegu. Specimens of *B. cœnopictus*, Hutton, were also met with in Upper Burma. *B. gracilis*, Hutton, occurs throughout Burma apparently. I have found a rather dwarf variety in Ava, Pegu and Arakan, and have received it from Molmein.

Achatina.

Achatina tenuispira, Bens., of small size, is common at Akoutoung and further south. A small variety of *A. crassilabris*, Bens., occurs in Arakan, and another form, perhaps distinct, but closely allied, was found in the Shan hills near Ava. The species of *Achatina* do not appear to be numerous in Burma; they attain their maximum in the Indian area in the Western Ghats, and the hills of South India and Ceylon, and their numbers diminish to the eastward.

Vitrina.

Vitrina præstans, Gould, differing in no respect from the Molmein shell, and *V. gigas*, Bens., equally identical with the Khasi form, are both met with throughout the Arakan hills, though sparingly. A smaller species, which I had looked upon as the young of *V. gigas*, has been correctly separated by Mr. Theobald, and will doubtless be described by him.

Ennea and *Pupa.*

Ennea bicolor was met with near Tongoop in Arakan, and at one or two places in Pegu. As in many other localities throughout its wide range, it is a scarce shell.

Pupa Avanica, Bens. occurs near Ava. I found it abundantly on a small hill, a few miles north of Mandélé.

Streptaxis.

Besides the species above described from Arakan, a smaller form occurs in Pegu, which I consider a variety of *S. Andamanica*, Bens., the only difference I can detect being in the sculpture, which is somewhat finer in the Pegu shells.

Hypselostoma.

I have nothing to add to the particulars of the distribution of the two species of *Hypselostoma* beyond those given in a preceding number of these contributions.

CYCLOSTOMACEA.

Cyclophorus.

In the Shan hills east of Ava, I found two forms of large turbinate *Cyclophori*, one apparently a variety of *C. speciosus*, Phil., the other so closely allied that I doubt if it is wise to describe it as distinct. *C. speciosus* does not appear to occur in Northern Pegu, but I found

it at Rangoon, close to the Pagoda, abundantly south of Bassein, and at Tongoop in Arakan. At Akyab I found some dead specimens, which may possibly belong to this species, but they are thinner, with a rather narrower umbilicus, and less broadly expanded peristome, and one specimen is subangulate at the periphery. In these characters they appear to be intermediate between the Burmese *C. speciosus*, Phil., and the Khasi hill *C. Pearsoni*, Bens.

At the base of the Shan hills, and also at Mya Leit Doung, I found the small species referred by Mr. Benson to *C. cornu venatorium*, Sow. Some living specimens at the former locality shewed the operculum to be normal.

At Mya Leit Doung occurs also *C. cryptomphalus*, Bens. of which I obtained fresh specimens, with the colour and epidermis perfect. When in this state, it is the handsomest of the Burmese *Cyclophori*, and equal in beauty of colouring to *C. Siamensis*, Sow., the dark blackish brown colour of the upper surface of the shell contrasting finely with the irregular zigzag white lines. The mouth, in my specimens, shews no distinct duplication: it is much thickened and expanded, as in *C. speciosus* or *C. Siamensis*.

C. fulguratus, Pfr., I did not find further north than Puppa hill. At Thayet Myo and Prome it is very abundant, and it occurs more sparingly throughout the Prome and Henzada districts, together with *C. Theobaldianus*, Bens. and *C. patens*, W Blanf. *C fulguratus* is a handsome shell, varying greatly in size, my largest specimens from Thondoung, south of Thayet Myo, measuring 38 millem. by 30, the smallest, a dwarf specimen, also from Thayet Myo, only 20 millem. by 15½.

Mr. Theobald, in a paper published in this Journal for 1863, (XXXIII. p. 376,) classes my *C. patens* as a variety of *C. fulguratus*. The types of both species occur together at Thayet Myo, and are very distinct, *C. patens* having a broad, rather thin disk-like expanded peristome, while the lip of *C. fulguratus* is much thicker but only moderately expanded. *C. patens* also is much smoother. However, intermediate forms may possibly occur, as they do between many other Burmese species.

At Tongoop in Arakan, and on Ramri island, I found a variety of the large *C. aurantiacus*, Schum. It approaches *C. Theobaldianus*

Bens., but has flatter whorls, a sharper keel, a more acute apex, and rather less strongly marked sculpture.

A small turbinate species of *Cyclophorus*, which I found at a considerable height on the Arakan hills between Prome and Tongoop, with a rounded periphery and very narrow umbilicus, requires comparison with *C. scurra*, Bens. Another form, with a subangulate periphery, was met with in Bassein district, and a third, rather larger, but otherwise identical, in Ramri island. All of these may be varieties of the same shell. All possess a very narrow umbilicus, a thin white expanded lip, and minute sculpture.

None of the small discoid Cyclophori, so far as I am aware, occur in Pegu. *C. hispidulus*, W. Blanf., I described in a previous paper as occurring at Mya Leit Doung, Ava. *C. calyx*, Bens. is stated by Mr. Theobald to occur at Akoutoung, Pegu, and that locality has been quoted for it by Mr. Benson in describing the shell, and repeated by Pfeiffer in Suppl. Mon. Pneum. p. 56. I think some mistake must have been made by Mr. Theobald in arranging and labelling the very extensive collections which he made in 1854-55, for the shell abounds in Molmein, while, although I have repeatedly searched all round the Akoutoung hills, I have not met with it.

Leptopoma.

In a previous paper (J. A. S. B. for 1862) reference was made to the occurrence of the Tenasserim *L. aspirans*, Bens., in Arakan, near Tongoop, and in the Bassein district of Pegu. It was found in great abundance in Long Island in the Bassein river. I also found specimens close to Akyab, in the hills on the opposite (south) side of the harbour. Some of these last are rather larger than the typical form, and measure 14 by 10½ millemetres in the two diameters and 12 in height; they are also smoother, wanting the raised spiral lines, and the last whorl is rounded or subangulate near the mouth : but other specimens are scarcely distinguishable from typical shells from Tenasserim, among which also some of the above characters, and especially the sculpture, are variable.

Pterocyclos.

Pt. pullatus, Bens., has only been found near Akoutoung. In Arakan, near Tongoop, and again at Akyab, I found a species closely allied to *Pt. parvus*, Pearson. The Akyab specimens possess their

opercula, which is flat like that of *Pt. pullatus*, and not convex as in *Pt. rupestris*, &c. These shells also closely resemble a species collected by Mr. Theobald at Cherra Poonjee, and referred by Mr. Benson to *Pt. Albersi*, Pfr., which has a convex operculum, and a peculiarly shaped wing. The specimens from Tongoop and its neighbourhood had a much thicker epidermis than those from Akyab, and were larger, but otherwise similar.*

No form of *Cyclotus* is known from Burma. I have shewn, in a paper published in the Annals and Magazine of Natural History for June, 1864, that the *Cyclophorus calyx* group approaches very closely to the true *Cycloti*, and represents them; while the *Cycloti* of India (e. g. *C. subdiscoideus*, Sow.) are allied to *Cyclostoma*, having the peculiar cleft foot and mode of reptation of that genus. I have proposed to place them in a new genus, *Cyclotopsis*.

Alycæus.

Much concerning the distribution of the numerous species of this genus has been communicated in previous papers. A brief recapitulation may be useful.

A. Avæ, W. Blanf., is the only form as yet found on the Shan hills, east of Ava. *A. Vulcani*, W. Blanf., occurs at Puppa hill, Pagán. About Thayet Myo, *A. sculptilis*, Bens., is abundant, especially on the hills a few miles south of the town, where also *A. armillatus*, Bens., was found in very small numbers, its minute size doubtless rendering the search for it difficult. A few specimens of a small variety of *A. umbonalis*, Bens., first appeared here. They have a "retro-relict" outer peristome, and coarse sculpture on the upper whorls. The typical variety is rather common at Akoutoung, the original locality. I found this species again at one spot, a little north of Bassein, near the village of Kani. The older specimens obtained there, and others from the base of the Arakan hills, west of Prome, had the outer peristome retro-relict as in the Thayet Myo variety, a peculiarity I never observed in the typical Akoutoung form.

* Since the above was written, I have heard from Mr. Benson, who has kindly compared the species with *Pt. parvus*. In the latter, the wing runs up the penultimate whorl, while the wing and sinus of the Akyab and Tongoop species resemble those of *Pt. pullatus*. In other respects the form resembles *Pt. parvus*. It may be distinguished as *Pt. Arakanensis*, n. sp. I have not specimens at hand, so cannot add a complete description.

At Akoutoung I also found *A. humilis*, W. Blanf., and at the same place, at Thondoung and at Yenandoung, two hills about 20 miles further south, I found a variety of *A. Ingrami*, W. Blanf., rather larger than the type from Tongoop in Arakan, and measuring 7 millem. in the larger diameter.

Another form of the same shell, with a less distinct subangulation of the periphery, and rather closer sculpture on the upper whorls, occurred at Moditoung, on the Prome and Tongoop road, with *A. graphicus*, W. Blanf., *A. succineus*, W. Blanf., neither of which has been found elsewhere, and one form of *A. vestitus*, W. Blanf.: *A. nitidus*, W. Blanf. and *A. polygonoma*, W. Blanf., were first found on the same road, but nearer to Tongoop. The latter I afterwards obtained in two or three places south of Bassein, the specimens being a little larger (6 and 5 millem. in their two diameters) than those first found. *A. vestitus* has only been found in the Arakan hills on the confines of the Henzada and Prome districts.

Adding to these the two new species above described, *A. politus* from near Cape Negrais, and *A. glaber* from Akyab, we have 14 species described from Ava, Pegu, and Arakan, besides 3 more from Molmein and Tenasserim, altogether nearly half the known species of the genus.

Pupina.

A species of *Pupina* occurs at Thayet Myo, Prome, Akoutoung, &c., closely resembling *P. artata*, Bens. from Molmein, but rather stouter in form and with a somewhat thicker peristome, which is frequently but not always orange in colour, instead of white. These differences do not appear, however, to warrant specific distinction, especially as there is much variation in the form of typical specimens of *P. artata*. A variety from Ava is closer to the type. A small form, probably another variety, occurred upon the Arakan hills near Prome. It is only $4\frac{1}{2}$ millem. long, but the specimens are unfortunately not quite fresh. My own specimens of *P. artata* from Molmein are but 6 millem. long. The operculum in fresh specimens is horny, not testaceous, the white appearance being produced by weathering, and I suspect the apparently paucispiral character to be due to the rapid increase of the interior whorls, which rest one upon the other, as in

Cataulus. Near the periphery, the whorls are more numerous, but their boundaries are indistinct.

I have in this and other papers, already given all the details connected with the occurrence of the four species of *Diplommatina* as yet described from Burma. The only known *Helicina* from Northern Burma is also described above.

Georissa.

I have described (Ann. and Mag. Nat. Hist. for June 1864) as a distinct genus, under this name, the species of Burmese and Khasi shells referred to *Hydrocena* by Mr. Benson, both the animal and operculum differing from those in that genus. But one species is known to exist in Pegu, *G. pyxis*, Bens., and I have met with that in many places west of the Irawady, from Thayet Myo to south of Bassein. *G. Frustrillum*, Bens., I only met with at the original locality, Mya Leit Doung, Ava.

It is evident that two very distinct zoological provinces exist in Burma, exclusive of Martaban and Tenasserim, which form a third, characterized by the appearance of several Malayan generic types, such as *Raphaulus*, *Hybocystis* and *Rhiostoma*, and others apparently peculiar, as *Sophina*. The two northern provinces are: 1st, Arakan, with the southern part of Pegu near the sea, enjoying a very humid climate. 2nd, Upper Burma, with, in many parts, a very dry climate. The boundary in the Irawady valley may be drawn roughly above Henzada, although species belonging to each fauna, as is usually the case, pass over the border. The first province, besides a considerable number of peculiar species, is especially characterized by forms common, on the one hand, to the Khasi hills, and even to the Himalayas, and, on the other hand, to Tenasserim. Examples of the first are *Helix plectostoma*, Bens., *H. delibrata*, Bens., *H. castra*, Bens., &c.; of the second, *Cyclophorus aurantiacus*, Schum., *C. speciosus*, Phil., *Leptopoma aspirans*, Bens., *Nanina honesta*, Gould, &c. In the Ava province, on the other hand, the forms which have also been found in India are mostly inhabitants of the plains, such as *Helix similaris*, Fèr., *Bulimus pullus*, Gray, and *B. cœnopictus*, Hutt. The genus *Hypselostoma* has as yet only been found within this province, or close to its borders. It is rich in species of *Plectopylis*, and in varieties or

allies of *H. similaris*. The Arakan Yoma north of Henzada separates the two provinces; the southern portion of the range, which is very low, rarely exceeding 1000 feet, is solely occupied by species belonging to the Arakan fauna. These provinces are also characterized by distinct forms of mammals and birds, and there is a great difference in their vegetation.

In a list of Burmese shells, published by Mr. Theobald in J. A. S. B. for 1857, (Vol. XXVI. p. 251) occur the names of *H. petila*, Bens., and *H. mensula*, Bens., from Thayet Myo, and *H. precaria*, Bens. from Tenasserim. These shells have never been described, and Mr. Theobald in this, as in other instances, has published lists of manuscript names communicated to him, some of which have subsequently proved to have been given in error. It is, I think, to be regretted, that in a recent paper J. A. S. B. for 1863, Vol. XXXII. p. 374, Mr. Theobald has again included one of these abandoned names, viz. *H. petila*, and he has also published the names of several of the species described above, and similarly communicated to him in manuscript. One of those thus published, *Alycæus scepticus*, has proved, on more careful comparison, and when additional specimens from other localities were procured, to be only a variety of *A. Ingrami*, and not a distinct species. Several of the names in Mr. Theobald's paper are incorrectly given, e. g. *Helix helicofera* for *H. helicifera*, *H. caussia* for *H. causia*, *H. pausa* for *H. pansa* but these are probably errors of printing. The practice of including, amongst lists of species, manuscript names, without any reference to the fact of their being unpublished, and consequently of no authority, is much to be deprecated, as tending to confusion and the multiplication of synonyms.*

Postscript.—Since the above paper was penned, now nearly 6 months ago, I have received Mr. Theobald's "*Notes on some Indian and Burmese Helicidæ, &c.*" published in this Journal for last year, pp.

* Besides the shells above mentioned in the Burmese list, the names of many other undescribed species occur in the paper, while many described species are omitted.

238, &c., which calls for a few remarks. Although I differ in many points from Mr. Theobald's views as put forward in this paper and in the earlier one of 1863, especially those on the origin, migration, and distribution of specific forms, I see no object to be attained in answering at length opinions long since refuted, as I believe, by far more competent authorities and far abler writers. The works of Edward Forbes, Owen, Lyell and a host of others besides Darwin, will serve to shew the arguments relied upon by the great majority of living naturalists, to prove the doctrine of "specific centres," that is the theory that all members of the same species, whether existing or dead, have descended, not necessarily from one pair, but from one parent stock, living in one spot. To call this, however, the Darwinian theory, as Mr. Theobald appears to do, would be paralleled by calling the earth's rotation round the sun the Newtonian theory. In each case the earlier theory is only a necessary step in the line of argument, and the hypothesis of the origin of species by means of Natural Selection is no more involved in the doctrine of specific centres, than was the theory of universal gravitation in that of the rotation of the planets around the sun.

If I refer briefly to one remark of Mr. Theobald's, (that in his first paper, J. A. S. B. for 1863, Vol. XXXII. p. 376) it is because it appears to me the only argument of any importance which he has advanced in favour of his opinions. The question of the distribution of fresh water shells and especially of the bivalves, with their limited powers of progression, is a well worn argument in favor of the sporadic origin of species; that is, of the descent of each species from many parent stocks, existing in distinct and separate localities. But if all the facts of the case are fairly stated, there appears much, even in this instance, in favour of the doctrine of specific centres. The facts are briefly these. Many species of *Unio*, e. g. *U. marginalis*, Lam. exist throughout a large tract of country, in almost every river and stream, and even in many ponds and marshes, although these rivers, &c. have no fresh water communication with each other whatever, and the animal is incapable of living in the sea, or of traversing the land. On the other hand, the area inhabited by this species is continuous; that is to say, the same species does not occur in tropical Asia and tropical America, for instance. Other species are restricted

to a single river and its feeders, as is the case, so far as is known, with *U. olivarius*, Lea. In other cases again, as in *U. cæruleus*, Lea, and its allies, one form is found over a considerable area, as Bengal, and in separate rivers, and is replaced at a distance, as in Scind and Western India, by forms which may either be considered as distinct species, or as local varieties, according to the value attached to specific rank. In the intermediate country of Central India, we find intermediate forms. Now it is surely more philosophical to assume that we are only partially acquainted with the phenomena attending the means of distribution enjoyed by animals of low organisation, especially in the young state,* than to arrogate to ourselves complete knowledge of the subject, and to assert that no means of passage exist. If we suppose that facilities for migration exist, or have existed, with which we are unacquainted, all the facts above detailed are at once accounted for in the simplest manner, whereas on the theory that the species were originally created throughout the whole area, no explanation whatever is afforded of the limitation of that area, no cause shewn why the same species does not exist in other areas where the conditions are equally favourable for its existence, and still less is any explanation afforded of the gradual divergence of varieties at a distance from the typical form. Let it be distinctly noted that the case of mollusks and of other animals inhabiting fresh water is an exceptional one; in the vast majority of the members of the animal and vegetable kingdom, the phenomena are far more strongly in favour of the theory of specific centres.

On another question, more especially treated in Mr. Theobald's second paper, viz.: the impracticability of drawing a line between species and varieties in many cases, I entirely coincide; indeed in the preceding pages will be found remarks upon the varieties of *H. similaris* and its allies, and of *H. rotatoria* and its allies, similar in purpose to those of Mr. Theobald. I must, however, object to the practice of publishing names, whether of varieties or species, without any description, or with such extremely inadequate details, as in the case of *Helix Arakanensis* and *H. geiton*. I can only say that,

* It should not be forgotten that the ciliated fry of the Unionidæ have very considerable power of locomotion, and that even the adults are amongst the most vagrant of bivalve shells.

although I probably possess the former, I am totally unable to tell, from Mr. Theobald's account, to which of the numerous varieties of *H. rotatoria* he has applied the name. Again, in this paper as in former ones, manuscript names are introduced without any reference to the fact of their being unpublished; and, in two cases at least, I believe I can shew that these names would never have appeared, had they not been cited by Mr. Theobald.

1st. *H. unicincta* was a manuscript name of Mr. Benson's for a shell from Western India, described by Pfeiffer as *H. propinqua*. Mr. Benson's name of course was never published, nor would it have seen the light but for Mr. Theobald, who, in his paper in 1863, gave *H. unicincta* as a species excluded from his list, without referring to the fact that no such name existed except in manuscript. In the present paper, *H. propinqua*, Pfr., is first given as a distinct species, and a few lines further on quoted as a synonym of *H. unicincta;* thus giving precedence to the manuscript name, in opposition to the laws of scientific nomenclature.

2nd. *H. anopleuris* was a manuscript name given by Mr. Benson to some shells sent by Mr. Theobald to England, I believe in 1860 or 1861. Mr. Theobald having kindly furnished me with specimens of the same shell, I found, on comparing them with the types of *H. ornatissima*, Bens., of which I had a good series, (the shell was first collected by my brother and myself and described from our specimens) that the species were identical in every respect. I wrote to Mr. Benson to tell him my opinion and on recomparing the forms, he found that he had been misled by an abnormal peculiarity in the solitary specimen of *H. ornatissima* which he had retained.

Another name mentioned by Mr. Theobald, *Helix submissa*, Bens., is equally, so far as I am aware, undescribed.

In the group placed by Mr. Theobald next after that in which the above shells are included, there is evidently a misprint, in the five shells from *H. infrendens*, Gould, to *H. sanis*, Bens., being classed together. I have no doubt Mr. Theobald's intention was to class together the three first, and, as a separate species, the two last.*

* I am authorized by Mr. Theobald to notify that this error was due to a misinterpretation of his manuscript. His intention was that suggested in the text. Ed.

As regards the new species described, *Limax viridis*, if it has no internal shell, and none is mentioned, can scarcely be a *Limax*. The characters given are mostly unimportant, while essential characters, such as the position of the mantle and breathing pore, surface of the mantle and body, carination or roundness of the back, form of the jaw and lingual teeth, are omitted. What advantage is gained by publishing names for a genus and two species of slugs, of which Mr. Theobald has unfortunately no notes, is not clear. *Vitrina Peguensis* is the shell referred to above as undoubtedly a well marked and distinct species. *Streptaxis Blanfordi* and *Pupina Blanfordi* are also mentioned above, they being, I believe, varieties of *S. Andamanica*, Bens., and *P. artata*, Bens., respectively. *Streptaxis Burmanica* I have described above, and as my description is more detailed, and taken from a better and more typical specimen than Mr. Theobald's, I have retained it. On the other species I have nothing to add.

In Mr. Theobald's 1863 paper, he referred my *Cyclophorus patens*, as I have before stated, to *C. fulguratus*. I can scarcely believe that he is now serious in proposing to unite these shells, because one is scarce and the other abundant, although that is the sole reason assigned. Even in this point, however, Mr. Theobald is not quite correct. I have found *C. patens* in some places the more common shell of the two.

On the question of the restriction of the genus *Nanina*, I can only say that Mr. Theobald's ideas are totally at variance with those of Pfeiffer, Adams, Gray, Albers, and other authorities. On the other hand he is probably correct in his opinion that *H. pansa* and some other shells do not belong to the section *Macrochlamys* of Benson, with which I had classed them.

Notes on the Sandstone formation, &c. near Buxa Fort, Bhootan Dooars.—By Captain H. H. Godwin Austen, *F.R.G.S., Surveyor, Topographical Survey.* Plate IV.

[Received 26th April, 1865.—Read 3rd May, 1865.]

Having heard from Asst.-Surgeon Fergusson, R. A. at Buxa, that he had found several pieces of coal in the bed of a nulla below the position near Santrabari, I paid a visit to the spot accompanied by that officer. Buxa Fort, at 2,400 feet, is situated near the foot of the first range of hills, that rise above it on the north to a height of 6,000 feet above the sea; this ridge being the continuation of the western water-shed of the Tzinchu, the river from Tassi Chotzong in Bhootan. The rock of this range is a well stratified gneiss, thick beds of quartzite occurring in it, being even schistose in places. The plateau on which stands the Fort of Buxa is composed of debris and talus from the hills above, and is situated in a valley formed by spurs from the northern ridge. The eastern of these spurs is of the formation mentioned above, but the western is found to be of sandstone, having a light ochre tint, coarse and micaceous, with here and there water-worn pebbles in strings; its stratification not being so well marked as in the sandstones of the Siwalik group. The ridges on the west of this are all of this same formation, but do not extend much higher than 3,000 feet. As one proceeds down the western spur to Santrabari, the sandstone is soon hidden by a surface talus of the older rocks, and the rock in sitû is only to be seen by descending into the deep ravines. Crossing the stream at Santrabari, proceeding east and topping a spur covered with sal trees, I descended into another ravine, very precipitous on the western side: here the sandstone was well displayed, and several pieces of the coal were soon found in the bed of the ravine. The outermost beds of sandstone are very soft, with a light bluish tinge, and in them the coal, properly speaking lignite, was discovered, occurring in lumps and strings: these lumps shewed the woody structure well, splitting in the direction of the fibre. The form of a portion of a tree pressed into an elliptical shape, was well seen in one instance, but I could find no impression of leaves.

The specimens had just the resemblance of drift wood imbedded in the sandstone. The dip was at a very high angle to the north, so that the beds were passed in succession going up the ravine, and had there been any thick seams, they must have been seen. Three hundred yards up the bed of the nulla, the softer sandstone was succeeded by one much harder, of a light colour and coarse texture. The lignite was found in this also, and the longest and thickest string yet seen was at this point. Yet, from the appearances of it and from so little lying in the water-courses, I did not think anything approaching to a seam was likely to be found; and, not having time to spare, I did not follow the ravine any higher. An inspection of the ravines to the east or west might bring to light larger masses of this lignite. The dip at this furthest point was N. E. by N. 70°. In the cliffs on the west, a very good section was obtained, and the highest beds, that appear upon the surface to be an unstratified talus, I now saw were horizontally bedded and resting quite unconformably on the sandstones below. These horizontal beds, of which about 150 feet was exposed, are composed of sandy clay and semi-angular gravel, with scattered large, partly water-worn masses of rock, some of large size. I append a section (Plate IV.) to illustrate the Buxa formations, which, I trust, will make my description plainer. I did not succeed in finding any fossils:—a longer search would perhaps have ended successfully,—so that it is impossible to say in what formation this isolated mass of sandstone will find a place.* The plateau of the Buxa position is probably the highest level of the horizontally stratified gravels. I believe some specimens of the lignite have already been forwarded to the Superintendent of the Geological Survey. Some specimens in which the woody texture is well displayed shall be sent by first opportunity.

* See a remark on this head in the Proc. As. Soc. for May, 1865, p. 91.

Note on Lagomys Curzoniæ, Hodgson.—*By* Dr. F. Stoliczka.

[Received 7th December, 1864.—Read 7th December, 1864.]

In the catalogue of the Mammalia of the Asiatic Museum, Mr. Blyth mentions *Lagomys Curzoniæ*, Hodgs. as a desideratum.* Mr. Adams quotes a "Lagomys, sp.?" as occurring plentifully in Ladak, (Proc. Zool. Soc. Lond. 1858, p. 520) and Major Cunningham also speaks of a "smaller species of hare, or *Lagomys*" as extremely common all over Tibet. (Cunningham's Ladak, p. 204!)

On my visit this year to the eastern provinces of Ladak I was fortunate enough to procure several specimens of what I believe to be *Lagomys Curzoniæ*, Hodgs. (Vide Journ. Asiat. Soc. Beng. 1857, Vol. XXVI, p. 207 and Ann. Mag. Nat. Hist. 1858, I. p. 80.) but Mr. Hodgson's description of this animal is very brief, so that it is hardly possible to recognise the species among the numerous members of this genus. The following description is founded on four specimens, of three of which the exact measurements are given below.

General hue of the upper body pale buff fulvous, with very slight rufous tint and tipped with dark brown; below whitish, with translucent dusky blue. The larger hairs of the fur measure about $\frac{7}{8}$th of an inch; the lower part, for more than half their length, of a dark, slaty blue colour, with silky lustre; the next portion pale fulvous and the tip dark brown or black. The fur is full and very soft, as Hodgson remarks, and can be readily distinguished from that of *L. rufescens*, Gray. Chiefly in old specimens, there are, on the sides of the upper portion of the body, a few long hairs intermingled, which measure up to one and a quarter inches; these are almost or entirely of a black colour.

On the lower part of the body the hairs are, for two-thirds of their length, dark slaty blue, and the rest pale.

The head measures nearly always one-fifth of the total length of the animal. The hairs on it are much shorter, and tinged with a dark rufous tint above; on the sides of the snout they are pale grey, in front of the eyes and below, pale white, while on the sides of the head itself there is a slight rufous tint marked, which is a little stronger all round the neck, and extends somewhat farther back on the upper body. The hairs round the neck are rather longer, but only half their length

* 1863, p. 133, foot note.

of a slaty colour, the rest being pale rufous; but a few of them are tipped with black.

The end of the snout, and of the upper and lower lips are dark blackish. The hairs of the moustaches are very long; some of them measuring three inches: the upper ones are chiefly black, the lower white, or half black, half white. The ears are comparatively rather large, oval, terminating with a very obtuse point; they are well covered with hair, thickest on the outside: the hairs on the inner surface being pale yellow, those on the outer much longer and softer, and distinctly rufous. The feet and soles are in accordance with the general hue, of a pale fulvous colour, only still lighter, and slightly, and only partially tinged with a rusty tint; the toes are black, claws long and dark brown.

The young animal does not differ in colour very much from the old one. It is usually much paler and the difference between the hue on the upper and lower portion of the body is far less distinctly marked. The slaty hue of the inner fur is also more translucent and the rufous tint on the head and the hinder part of the ears not so strong.

The measurements of three specimens from Rupshu, the eastern province of Ladak, are as follow:—

	a.	*b.*	*c.*	
Total length of the animal, ...	7.50	9.00	9.50	inches.
Length of the skull, ...	1.90	2.25	2.37	,,
Proportion of the length of the skull to the total length, ...	0.26	0.25	0.25	
Width of the skull, ...	0.87	1.25	1.25	,,
Proportion of width to length of the skull, ...	0.46	0.55	0.52	
Length from the snout to the eye, ...	0.75	1.00	1.00	,,
Length from the eye to the ear, ...	0.93	1.12	1.12	,,
Length of the ear, ...	0.62	1.06	1.00	,,
Width of the ear,...	0.56	0.87	0.81	,,
Proportion of width to length of the ear, ...	0.90	0.82	0.81	
Length of fore foot and nails, ...	0.87	1.12	1.12	,,
Length of hind foot and nails, ...	1.25	1.50	1.43	,,

(*a.*) Young specimen from above the Gyagar lake in Rupshu.

(*b.*) An old, full grown specimen from near Kozak on the Chomoriri lake in Rupshu.

(*c.*) Judging from the teeth, this seems to be a very old specimen, from the east side of the Lanak pass, west of Haule.

This latter specimen has the fur considerably worn off and injured. I found in the skin of this and some other specimens, which I shot in the Puga valley, a great number of larvæ of an *Œstrus*, which causes the injury and a sort of roughness of the fur. As the tips of the hair get worn off, the hue becomes in some places dark spotted, which is caused by the slaty colour of the interior portions.

It will be seen from the given measurements, that the skull of the young animal is in proportion to the entire body, a little longer and broader than that of the adult, and the ears are also somewhat larger. These proportions may be often observed in Mammalia of different ages.

Lagomys Curzoniæ is one of the largest known species of the genus. Our largest specimen measures $9\frac{1}{2}$ inches, which is only one line less, than the greatest measurement of *Lagomys alpinus*, Pallas. (Vide Waterhouse Mammalia, Vol. II., Rodentia, p. 16.) Mr. Hodgson's specimens were much smaller and probably younger. I observed several which were not longer than seven inches, but most of them were about nine inches long.

The people of Korzok called *L. Curzoniæ*, *Phise-karin*, which means as I was informed, *tail-less Phise*. *Phise* or *Pheese* is the name of *Phaiomys Cucurus*, Schreber, which lives here associated with the *Lagomys* and *Arctomys*. The name *Phise-karin*, I was told, is Tibetan, and the Ladak name for *L. Curzoniæ* is *Sabra*. Hodgson gives the name *abra ;* it is, however, well known, that the letter *s* before many words is in some parts of Tibet pronounced, in others not so.

The first place, where I met with *L. Curzoniæ*, was a little above the junction of the Chomoriri with the Para valley at a height of about 15,500 feet above the level of the sea. It does not live usually at a lower elevation than this ; and if otherwise, as in the lower parts of the Puga valley (14,500 feet,) it is always scarce. Round the Chomoriri lake, where there is comparatively plenty of vegetation, it is associated with *Phaiomys Cucurus*, Blyth, and *Arctomys bobac*,

Schreber.* The first never frequents a great elevation above the bottom of the valleys and is especially numerous in the neighbourhood of streams. *Arctomys bobac* (called by the Tibetans *Phya*) makes its very deep burrows mostly on the sides of the valleys and near their bottom; it ascends, however, the slopes of the hills in this portion of Ladak to a height of 17,800 feet. This greatest elevation, at which I observed it, was near the Samunda-là, south-east of the Chomoriri; while the lowest was in the Para valley about 15,400 feet. It lives probably lower than this.

L. Curzoniæ ranges, however, somewhat higher. I noticed it on the top of the Lanak pass at an elevation of 18,672 feet, where only two minute plants existed, *Stracheya Tibetica*, Bth. and *Capsella Thomsoni*, Hf. both flowering in August.† It is found associated with *Corvus tibetanus*, Hodgs., *Gyps fulvus*, Gmel. and a new species of *Procarduelis*, among birds; an *Argynnis*, among butterflies and some common flies, forming the highest observed animal life in these hills. In fact it is difficult to design a limit to the height up to which *L. Curzoniæ* lives. I believe, it ranges as high as any trace of vegetation exists, which would be here about 19,000 feet, or very near it. Between the two given limits of the Para valley and 19,000 feet, it is seen in great abundance all over the eastern portion of Ladak. It is certainly the species of Adams and Cunningham, as there is to my knowledge, no other *Lagomys* here, at least none so common. Its geographical range must extend farther to the east and south-east, as Mr. Hodgson obtained his specimens from the district of Chumbi, (north-west of Sikkim?). I have not observed it SOUTH of the Bara-latse range, either in Spiti or in the south-eastern part of Lahoul, the Chandra valley; although *Phaiomys Cucurus* does occur in both provinces and even in *Kulu*. In Spiti, *Lagomys Curzoniæ* is represented by the smaller *L. Roylei*, Ogilby, which there lives between 12,500 (above Lari) and 16,000 feet, but usually about 13,000 feet.

* Mr. Blyth (Cat. of the Mammalia of the Asiatic Museum, 1863, p. 109) unites and, I think, with good reason, Mr. Hodgson's *Arctomys tibetanus* and *hemachalanus*, [*Himalayanus* was not used by the first author] as well as *Arct. fulvus*, Evers., with the species, which became first known through the travels of Pallas in Northern Asia, and which Schreber named *A. bobac*.

† Dr. Thomson (Travels, p. 144) mentions three plants on the Lanak pass, a little *Arenaria* or *Stellaria* and two Cruciferæ.

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Notes on Central Asia.—By M. SEMËNOF. *(Communicated by Lieut.-Colonel* J. T. WALKER, *R. E.)*

[Received 15th April, 1865.]

[In the year 1856, M. Semënof was deputed by the Imperial Geographical Society of Russia, on a mission of exploration into Central Asia.—On his return to St. Petersburg, he published a translation of Ritter's "Erdkunde von Asien" into Russian, and gave in the preface to the 2nd volume, an account of the results of his own explorations.—The following notes are taken from this preface. At my request they were translated from Russian into English by Mr. R. Michel, F. R. G. S., whose name will be familiar to all who are acquainted with the numerous papers on the geography and trade of Central Asia, which have appeared of late years in the Journal of the Royal Geographical Society of London. J. T. W.]

The second volume of the Russian translation of Ritter's "Asia" comprises a description of the North Western portion of the tableland of Asia, *i. e.* that extensive region which stretches between the Altai and the Celestial mountains, from the Eastern extremity of the latter at Hami (Komul), to the Watershed of lake Balkhash.

The range of country under consideration embraces the whole of the extinct kingdom of Djungaria, or the Chinese Province of Tian-

Shan-bey-Lu (the region to the northward of the Celestial mountains, consisting of the districts of Ili, Tarbagatai, Gobdo, &c.) and likewise the Russian districts of Alatavsk, Kopal and Ayaguz, which now constitute the new Semipalatinsk region. The whole of this country, including, both Chinese and Russian Djungaria, forms that most obscure and unknown portion of the interior of Asia which contains within it the very centre of the Asiatic continent, namely the gigantic mountain group of the Tengri-Tag, (a part of the Celestial mountains) situated at equal distances from the Black Sea, on the West, and the Yellow Sea on the East, the Obi Bight on the North and the Bay of Bengal on the South, and lying in the centre of the straight line connecting Cape Severovostochui in Siberia with Cape Comorin in India.

This region offers, moreover, special interest in physical as well as in ethnographical and historical aspects. Physically, it forms a distinct limit between the highland and the depressed portions of Asia, and is remarkable for the contrast it presents between its gigantic mountain groups of the Bogdo and Tengri-Tag in the Celestial range, which tower far above the limits of eternal snows and are crowned with large alpine glaciers, and the low sandy and sterile steppe of the Bedpak-Dala, on the South West of lake Balkhash, which, in common with all the other sandy wastes of the Aralo-Caspian depression, bears the character of a bed of an inland sea, dried up during a very recent geological period. In ethnographical respects this region offers a contrast no less marked, between two numerically preponderating central Asiatic races—the Mongolian and Turkish,—whose rulers are Chinese and Russians, strangers from the far East and West, occupying, in the same alluvial plain of the Balkhash, small populated oases in the midst of an indigenous population alien to themselves in speech and habits, and who are powerful not by reason of their numerical superiority, but by the weight of their civilisation, and the magnitude of their respective Empires, the most colossal on the face of the globe. Lastly, from an historical point of view this country presents features of a no less interesting character. It has served from time immemorial as the point of departure for migrating races from the highlands of Asia, the cradle whence they sprang, to the low arid steppes of the Aralo-Caspian depression, and to the still more distant and

better favoured regions of the West. It was here, namely, in Djungaria, and on the fertile and smiling banks of the Ili and Irtysh, that the migrating hordes lingered for some time, both, as it were, to venture out into the unknown plain stretching before them far away into the sandy ocean that separates Europe from Asia, until a new tide of popular migration forced them at last to strike their tents, and depart westwards from their mountainous halting grounds. It is also in the valleys of Djungaria that a few existing rude monuments, crude traditions, geographical names, and remnants of tribes who, in many cases, have lost their native dialect by intermixture with other races (the result of which appears in the name of Kassak or Kerghiz Kaisak), serve the scientific explorer as the only links for identifying the obscure and fragmentary allusions concerning these migrated hordes, which occur in Chinese and Russian chronicles.

Although the physical and ethnographical characteristics of Central Asia have attracted the constant attention of some of the most learned men, such as Humboldt, Ritter, Abel Remusat, and Klaproth, the researches of these leaders of science could only be based on the most meagre data, namely on the dry and one-sided Chinese narratives which found a place in Chinese literature, from the period of the dismembêrment of the Djungarian kingdom in the middle of the last century, and also on the inaccurate, brief and conflicting accounts and itineraries of a few Asiatics, who succeeded in visiting Djungaria and Little Bokhara with caravans. All these materials were collected and carefully collated by Ritter and Humboldt; nevertheless this region remained up to the most recent period, like the interior of Africa, completely inaccessible to European science.

Even Marco Polo, the most enterprising and reliable traveller of the middle ages, did not visit this region, but proceeded eastwards to China by a route that lay southward of the Celestial range. A few other travellers, it is true, passed through Djungaria; these were Plano Carpini (1246), Andre Songjumel (1249) and Wilhelm Rubriquis (1252); and they probably journeyed by way of lake Faisan to Karakorum the capital of the Mongol Khans.

The same route was traversed by some of the subjugated Western princes, such as Yaroslof and Alexander Nevski of Russia and Getum of Armenia (likewise in the middle of the thirteenth century) for the pur-

pose of paying homage to the great Khan; they, however, either left no description of their journey, or else their accounts are so meagre and confused, as for instance, the narrative of Prince Getum, that very few of the places mentioned in them can be identified. Much later, in 1654, Fedor Isakonitch Baikof, the envoy of the Russian Tsar Aleksei Fedorovitch, proceeded past lake Faisan, and the upper course of the Black Irtysh, and traversed the whole of Djungaria, reaching the Chinese wall at Huhu-Hoton from whence he advanced to Pekin.

Although Baikof's marche-route (of course not in the form it is inserted in Wilson's work from which it was derived by Ritter, but in the shape we find it in Spasskis' "Sibirski Vestnik") can, in the present state of our knowledge of the geography of Central Asia, be pretty readily applied to certain localities, still the information it contains is of a meagre character, and is greatly inferior to native Chinese accounts.

The Southern border of the country now under consideration, *i. e.* the gigantic Celestial range, has not been explored by any European traveller up to the present day. The destruction, however, of the kingdom of Djungaria, by the Chinese, led to its being surveyed under the superintendence of the European missionaries Felix d'Arocha and Hallerstein, by whom astronomical points were determined, not alone in the towns of Djungaria and Little Bukhara, but also at the very foot of the Celestial range, as at Hongor Olen the modern Konur-Ulen, and on the Southern shore of lake Issyk-Kul. As the Jesuits have left no record whatever of their having visited any part of the Celestial range, it must be naturally concluded that they themselves did not diverge from the highroads of Central Asia, but detached a party of Chinese topographers, instructed by themselves, to the base of the Celestial mountains.

The first learned Russian traveller who penetrated into the part of Inner Asia described in the present volume, was the botanist Sivers, who in his hazardous and venturesome journey to the Tarbagatai, in 1793, advanced as far as 47° N. Latitude. During the succeeding forty years, not one of the scientific explorers of Western Siberia succeeded in passing beyond the point previously reached by Sivers.

The journey of K. A. Meyer in 1826, did not extend beyond the Arkat mountains, Chingiz-tán, and the Karkara district of the Kirghiz Steppe. The travels of Humboldt, and his associates, in 1828, did

not embrace even Djungaria. Their extreme limit was the Chinese picket of Baty, on the Irtysh, in 49° N. Latitude, and Humboldt's greatest service in connexion with the geography of the interior of Asia consists in the critical elaboration of the materials relating to this subject in his classical " Asie Centrale."

Some of these materials, namely the itineraries of Asiatic traders, who had visited different parts of Asia with caravans, were diligently collected at Semipalatinsk by Humboldt, and another portion of his materials was derived from Chinese sources that had been elaborated by the European *Sinologists*, Abel Remusat, Klaproth, Schott, Neuemann, St. Julien, Father Hyacinth, and others.

Among the few unscientific eye-witnesses who, in the pursuit of trade, penetrated into Inner Asia, were some Russians, and among these in point of lucidity, and accuracy of information, the first place is undoubtedly occupied by the interpreter Putinsef, who, in 1811, visited Kuldja and Chuguchak, the most flourishing towns of Djungaria. The narrative of this journey was published in the " Siberski Vestnik" translated by Klaproth, and served Ritter as one of the most valuable sources in elucidating the geography of this region. In addition to Putinsef, we may mention the miner Snegiref, who, towards the end of the last century, proceeded from the Altai to the neighbourhood of Chuguchak, in search of gold; also the noble Madatof, who, in the early part of the present century, successfully reached India, starting from Semipalatinsk, and traversing lake Issyk-Kul, the Celestial mountains and Little Bokhara. A short account of Snegiref's journey was printed in the " Siberski Vestnik," but with Madatof's expedition I am acquainted only through official documents preserved in the archives at Omsk, and as no original narrative was discovered by me, it must be presumed that none ever existed. I also found a short marche-route at Semipalatinsk, drawn up by the merchant Bubeninof, who, in 1821, proceeded from Semipalatinsk to Kashgar. This itinerary will be printed in due season, but from its brevity and scantiness of information, it is in no respect more valuable than the itineraries already printed and digested by Humboldt and Ritter.

Such was the unsatisfactory condition of our knowledge of the geography of Central Asia in 1831, at the time of the appearance of that part of Ritter's work which relates to it. It was only in

the fourth decade of the present century that we became more familiar with Central Asia, from the side of the Djungarian and Kirghiz steppes, after the foundation of the Russian town Ayaguz, on the upper course of one of the rivers of the Balkhash basin, and after the submission of a portion of the great Hordes under Sultan Sûk, son of Ablai Khan. These events gradually rendered not only lake Balkhash, but also the mountainous districts of Djungaria, more accessible to travellers.

In 1834 the astronomer Fedorof was enabled to reach the embouchure of the Lepsa, and determine its geographical position, under 46° 2½′ North Latitude. He also succeeded in visiting the southern shore of lake Faisan and in making a trigonometrical measurement of Tarbagatai. A little later, the relations of Russia with the Kirghiz Hordes became more satisfactory, and in 1840, 1841 and 1842 the learned travellers Karelin and Schrenk, penetrated into the mountainous portions of Djungaria or the Snow-clad Djungarian Alatau. Karelin explored the wild valleys of the upper courses of the Lepsa, Sarkan and Baskan rivers, as high as the snow-line.

Alexander Schrenk visited, and it may be said discovered to science, the lake Ala-Kul, crossed over the Djungarian Alatau to the Chinese side, attained the upper course of the Tentek, and reached the snow line on several occasions. The extreme limits of his journey on the plain bordering lake Alakul, were the Chinese town of Chuguchak, in Alpine Djungaria,—the hills skirting the banks of the Koksu river, and the river Chu (or Tzu) in the hungry Betpak-Dalor desert, South West of lake Balkhash. Subsequently the voluntary submission of the remaining portion of the so-called Great Kirghiz Horde, in 1844, led to the Russian occupation of that rich and fertile portion of Djungaria, which is known under the name of the Semipalatinsk region, from the seven tributaries of the Balkhash that water it. The Russian town of Kopal was founded by Governor General Prince Gorchakof, in 1846, on a fertile plateau at the base of a snow-capped spur of the Djungarian Alatau. The establishment of this town ensured the development of the already existing relations of Russia with the neighbouring Chinese province of Ili. Although rapidly increasing, the trade with the Western Chinese region, through the towns of Kuldja, and more especially Chuguchak, encountered

obstacles in its legitimate development from its transitive and contraband character, as the Chinese of the Western region (Si-yui) were only able to have secret dealings with the Russians under a semblance of trafficing with the Kirghizes. It was this disadvantageous state of things, that led to the mission, with objects partly diplomatic and partly geological, of E. P. Kovalefski accompanied by Vlangagli, an officer of mining Engineers.

This expedition started from Kuldja, and skirting the Russian side of the Djungarian Alatau, traversed the valley of the Koksu, as far as the upper sources of this river, while, on the Chinese side, it reached the town of Kuldja, on the Ili. The most important results of this mission in commercial, as well as in scientific respects, were the establishment of Russian trading factories at Kuldja and Chuguchak. The opening up of the Western Chinese region contributed largely to the increase of our knowledge of the geography of Asia, inasmuch as it threw two learned Chinese scholars into the commercial centres of Djungaria in the capacity of consuls. The local researches of these sinologists has opened a wide field to science. Mr. Fakharof, one of the consuls, has already collected materials of great value relating to the physical geography and cartography of Inner Asia; these materials he has obtained during his stay at Pekin, from rare geographical works (namely the reports of the Survey made during the reign of Tsian-Sun) and from information supplied him by natives of the Western region. The foundation of the town of Kopal, which was in a satisfactory and flourishing condition, owing to the rapid development of agriculture aided by artificial irrigation, could not, however, secure the great Hordes, now under Russian dominion, against the bold attacks of the Buruts, or the so-called Black or Dikokamenni Kirghizes, who infested the valley of lake Issyk-Kul, and the neighbourhood of Tekes on one of the sources of the Ili. This was naturally to be expected from the position of Kopal which stood on the northern confines of the Hordes, whose southern boundary, beyond the Ili, remained completely unprotected. The unguarded condition of the frontier of the Russian Empire on this quarter induced Governor General Hasford to occupy the so-called Trans-Ili country extending between the river Ili, and the snow-line of the gigantic Trans-Ili Alatau, with a view of securing the left flank of the Kirghiz Steppe

which was under Russian protection, by making it conterminous with the peaceful frontier of China and the natural snowy mountain boundary. This well conceived plan was carried out with complete success. In 1853 the first Russian detachment, under the command of Colonel Gulkofski, was despatched beyond the Ili; it, however, met with serious opposition from a strong body of Kirghizes belonging to the hostile tribes of the great horde who supported themselves on Fort Trichubek on the river Kesen. But in the following year the whole of the region was occupied by a force under Lieut.-Colonel Peremyshelski, who razed the Kirghiz fort to the ground; after this some of the tribes submitted to Russia, while the most inimical fled into Kokanian territory, and to the banks of the Talas and Syr-Darya.

The Russian detachment passed the winter in the sheltered valley of the Talgar, and in the ensuing year of 1855, General Hasford founded Fort Vernoé, at the base of the Trans-Ili Alatau, at the head of the Almatynka valley, which is picturesquely wooded with apple and apricot trees.

The occupation of the fertile Trans-Ili region, well adapted for agricultural and gardening purposes, and in all respects bountifully endowed by nature, had the effect of protecting the great Hordes from the attacks of the Buruts, but placed its nearest tribes in the same position as that occupied ten years previously by the Great Kirghiz Horde. The powerful and numerous tribe of the Bogus, who occupied the picturesque valleys and table-land between the Celestial mountains and the Trans-Ili Alatau, received neither countenance nor support from the Chinese, to whom they were nominally dependent, in resisting the fierce attacks of the Sary Bogish tribe; they had at the same time to repel, on another quarter, the depredatory incursions of some of their neighbours of the great horde. Consequently, soon after the occupation of the Trans-Ili region by the Russians, the High Manap of the Bogu tribe, the old Burambai, claimed the assistance of General Hasford against the attacks of the neighbouring tribes, and voluntarily tendered the submission of himself and his tribe to the Russian government. This led to the despatch of the first Russian detachment from Vernoé to lake Issyk-Kul, for the purpose of pacifying the two contending tribes, and making a reconnaissance of the hitherto unex-

plored valley of lake Issyk-Kul. Colonel Khomentofski, the officer in command of this force, and General Siverhelm who was in charge of the Survey of the newly organized Semipalatinsk region, were the first educated Russians who beheld this extensive lake and the snowy summits of the Celestial range. Unfortunately this detachment in consequence of its critical position amidst the wandering mountain tribes, the animosity of one of which against the Russians was decided, while the friendliness of the other was open to much suspicion, was soon recalled, and the surveying parties were unable to penetrate into the interior of the Celestial mountains. The southernmost point attained at the foot of the Tian Shan, by Ensign Yayooski the topographer attached to the expedition, was where the Faùkû rushes out if its narrow defile on the Issyk-kul plateau.

In the same year of 1856 I was sent by the Imperial Russian Geographical Society on an expedition to explore those mere accessible portions of Central Asia, which had previously been but little visited. Naturally the great object of attraction for me on this journey was the Tian-Shan or the Celestial range. The signification of this stupendous chain in position the most retired in the whole continent of Asia, had already been pointed out by Ritter and Humboldt; but the labyrinth of the Celestial mountains had not as yet been penetrated by any scientific traveller.* All the learned and critical researches of Ritter and

* Atkinson, the English artist, in his travels, which were published in 1858, gives an account of his journey from the river Kurchum, in the Southern Altai, across the Black Irtysh to lake Ubsa-noor, thence southwards, past Ulusutai, to the neighbourhood of the Chinese town of Barkul, at the base of the Tian-Shan; travelling then parallel with this chain, though at a considerable distance from it, as far as the meridian of Bogdo O'la mountain, and finally proceeding in a North Westerly direction, past lake Kyzyl-bash, until he reached lake Ala-kul in Russian territory. Unfortunately so extraordinary a journey, unprecedented in the history of the exploration of the Asiatic Continent, has had no beneficial scientific results. The narrative, which occupies 115 pages of text, so little characterises the explored region, that it might with equal fitness be applied to any portion of the Kirghiz Steppe. The critical enquirer finds nothing throughout the whole narrative, to satisfy him of the genuineness of the described journey, which extends over no less a distance than 3,000 miles of Chinese territory. This is the more striking as undoubted proofs of the actual performance of journeys of which descriptions have been given, may easily be found in the short itineraries and accounts of travellers of different ages and nations; as for instance in the travels of Huc and Gabet, in the marche-routes of Tartar traders, collected by Humboldt, and in the more ancient accounts of Baikof, Marco Polo, the Armenian prince Getum, in the marche-route of the army of Gulagu Khan, (compiled by one of his officers in the 13th century) and lastly in the narrative of the travels of the Buddhist Missionaries Fa-Hian

Humboldt respecting this range partook, even by the admission of the latter, of the character of conjectural geography, founded on a comparison of the obscure and confused narratives and descriptions

and Huan-Tsan, in the 4th and 7th centuries. Concise though these accounts doubtless are, the learned critic soon discovers in them such local peculiarities as can only be descriptive of particular spots and localities, and as we become more intimate with the geography of the country to which such accounts apply, the more readily and clearly do we identify the points given in these marche-routes. To our great regret we do not find this to be the case in that part of Atkinson's work which relates to Chinese Djungaria. From the commencement, in calling the Tian-Shan Sayan-Shan, he confounds, in name at least, the two principal mountain systems of Inner Asia; and in all the other portions of his narrative, where he does not confine himself to descriptions of the Steppes, the chase of wild animals, and the social customs of the nomads (descriptions which would apply with equal force and truth to the whole of Central Asia) but wishes to communicate something more definite and locally characteristic, he falls into numerous incongruities. Thus, to cite some examples, he speaks of the Kara-Tyn snowy range, at the upper course of the Black Irtysh, as of a level steppe intersected by low ridges; again, from the Tannu mountains, situated at a distance of 120 miles to the N. E. of Ubsa-noor, he sees the Bogdo-Ola in the Tian-Shan, which is about 750 miles away from this point. Lastly from the plain at the base of the Celestial range, he simultaneously sees not only the Bogdo mountain, but also the Baishan or Pé—Shan (emitting smoke by Atkinson's account), which is about 300 miles beyond to the westward, notwithstanding that the snowy Bogdo-Ola group stands out as is well known, considerably in advance of the main chain of the Celestial mountains, and the Baishan mountains rise on their southern slope, that is to say beyond its gigantic snowy ridge, in the neighbourhood of the Little Bukharian town of Kucha. Similarly as little confidence do those inconsistencies inspire which occur in his account of the time occupied in performing the various journeys, and in his description of the distribution of the nomad Kirghiz population, throughout Chinese Djungaria. As regards ourselves personally, the involuntary doubts respecting the abovementioned portion of Atkinson's travels are still further strengthened from information we gathered on the spot regarding his journeys, from the Cossacks who accompanied him, and from the commanders who provided him with escorts. Atkinson, during his many years' residence in Siberia, visited the neighbourhood of Kopal, that had then just been founded, many valleys of the Djungarian Alatau, the lake Ala-Kul, Tarbagatai, the rivers Narym and Kurchum in the Southern Altai, the Teletsk Lake, Tunkinsk mountains of the Sayan range, Irkutsk Kiakhta, &c. but as regards his travels over an extent of more than 4000 *verts* in Chinese territory, *accompanied by three Narym or Kurchum Cossacks*, I regret to say that I not only could not gather anything to confirm this fact, but I was convinced of its utter impossibility, from existing local conditions on the Russian as well as on the Chinese side. On the Russian, because the protracted detachment of these Cossacks, or their voluntary absence from the corps, is a fact that would leave behind it some record in the official archives, while on the Chinese side, the journey lasting more than six months, of a party unacquainted with the local dialect, and passing through inhabited districts, along established routes, and across the picket and frontier lines, could scarcely escape the vigilant eyes of the Chinese authorities. Under all these circumstances, and in the absence in Atkinson's narrative of any new data relating to Chinese Djungaria, this work cannot be considered as an acquisition to science, until the author adduces more definite information and stronger proofs, in corroboration of his accounts which involuntarily inspire certain mistrust.

of Chinese and other Asiatic travellers, commencing from the Buddhist Missionaries Fa-Hyan and Huyan-Tsan of the 4th and 7th centuries, to the brief itineraries of the Semipalatinsk Tartar traders of the present century. Numerous questions, replete with interest to the science of geography, could only be possibly solved by actual investigation on the spot. The configuration of the country, the direction of the upheaval of the mountain chain, its mean height, the altitude of its mountain passes, the height of the snow-line, the distribution of animal and vegetable organisms, the existence of Alpine glaciers or of volcanic action,—points all requiring either investigation, or confirmation. So far back as 1851 and 1852, during my stay at Berlin, I acquainted Humboldt and Ritter of my intention of proceeding into the interior of Asia as far as the Tian-Shan range. They both encouraged me in my difficult enterprise, but did not conceal their doubts as to the possibility of penetrating so far into the interior of the Asiatic Continent. The result of my deliberations with these leaders of science, strengthened me in my determination of attempting to reach the eternal snow-line of the Tian-Shan at all hazards. Humboldt attached so much importance to the investigation, even a cursory one, of this range, that I could not look at the undertaking but in the light of a holy mission, marked out for me by the Nestor of European savans.

By the end of the summer of 1856 under the auspices, and with the co-operation of the Russian Geographical Society, I was already in Vernoé. Unfortunately, however, I arrived two months after the visit of a Russian detachment to lake Issyk-Kul.

With a small escort of twelve cossacks, I succeeded, on the $\frac{9}{21}$ September, in reaching the eastern extremity of the lake, and had an opportunity of surveying from point Kuké-Kul-usun, the imposing range of the Tian-Shan, from the Djirgalau to the opposite extremity of the lake. To visit the chain itself was that moment impossible. My escort being so small, I was obliged to proceed very carefully, and passed the night among inaccessible defiles, anticipating every moment to be attacked by hostile bands of Kara-Kirghizes.

Returning to Vernoé, and procuring a larger escort (40 cossacks) I proceeded through the wild Bûam defile, at the upper course of the Chû, and emerged on the base of the Celestial range, near the Western

extremity of the lake Issyk-Kul. Here I came upon numerous encampments of the hostile Sary-Bagysh tribe, who shortly before my arrival, had had a fierce engagement with a Russian detachment; which had been sent out from Vernoé, to punish these mountaineers, for acts of violence and plunder. Notwithstanding that, I met with a hospitable reception from the Sary-Bagyshes who were commemorating the death of many of their kinsmen who had fallen in the recent conflict, I was not able to penetrate beyond the first exposed rocky spurs of the Celestial range, nor to visit its wild defiles, being apprehensive of treachery from the revengeful mountaineers, who had lately been so severely punished by the Russians.

However, in the spring of 1857, thanks to the escort kindly furnished me by Governor-General Hasford, who displayed great zeal and energy in furthering the organisation and exploration of the newly acquired region, I was enabled to realise all my plans. The deadly strife between the two Kara-Kirghiz tribes was then at its height, and the valleys of the Tian-Shan seemed quite inaccessible. A happy combination of circumstances, however, removed this apparently insurmountable obstacle to my journey.

A rumour, that had spread with extraordinary rapidity, through almost the whole of the Mustag (the Turk name for the western portion of the Tian-Shan) of the approach of a strong Russian detachment, armed with terrible instruments of destruction,* for the purpose of assisting the Manap Burambai, produced a sudden panic among the Sary-Bagysh tribe, inducing them to relinquish, not only the camping grounds they had seized from the Bogus, but even their own native pasturages, from the upper course of the Djirgalan, along the whole border of Issyk-Kul, for an extent of more than 200 *versts* and to migrate to the upper course of the Syr-Daria (Marym). The Bogu tribe who had been previously attacked by the Bagyshes in the spring of 1857, and driven into Chinese limits, expected their complete destruction; the sudden flight of their enemies dispelled their fears and enabled them to re-occupy their former camping grounds, and

* The exaggerated accounts respecting the strength of my escort were owing to my having really reached Burambaisaúls accompanied by 800 horsemen; but these consisted of a body of Kirghizes of the Great Horde under the Sultan Tezek who had voluntarily joined my detachment. My own personal escort consisted of only 25 cossacks.

even to reap the harvest that had been left standing in the fields by the Sary-Bagyshes. Attributing this favourable turn in their affairs to my approach, they rendered me every assistance for my journey. With such material assistance, I was able in July of 1857 to wind round Issyk-Kul from the south side and to reach the summit of the imposing and terrible Faŭkŭ-Davan mountain pass; I also succeeded in gaining the sources of the Narym, which forms the system of the Syr-Daria or Jaxartes. Shortly after, I penetrated in a more easterly meridian, much farther into the heart of the Celestial range, and ascended one of the most elevated mountain groups of Inner Asia, that of the Tengri-Tag, which is crowned with a circle of alpine glaciers, and covered with a dazzling mantle of eternal snows. In the glaciers of the Tengri-Tag I discovered the source of the Sary-Djaza, which belongs to the system of the Tarym-gol or Ergeŭ the most remote of the considerable rivers of the Asiatic Continent.

On my return to St. Petersburg in 1858, the Imperial Russian Geographical Society, taking into consideration the great scarcity of astronomical points in the region I visited, organised at my recommendation, and with the co-operation of the Military Topographical Depôt, a new expedition, under Captain Golubef, for the purpose of determining astronomical points in Russian Djungaria, and on the Lake Issyk-Kul. By last accounts, Golubef had ascertained the position of three points in the valley of Issyk-Kul lake (on the Tekes river, and at the eastern and western extremities of the lake respectively), but he had not succeeded in penetrating into the interior of the Tian-Shan, owing to adverse circumstances, as the southern shore of the lake of Issyk-Kul was at that time occupied by the hostile Sary-Bagysh tribe; under such a state of things it would of course have been extremely rash to advance into the mountains, leaving hostile tribes in his rear.

All the journeys and researches, since the year 1834, enumerated above, have considerably advanced our knowledge of the portion of Asia which we are now considering, and have removed it from the region of hypothetical speculation, to a certain basis of scientific investigation. On this account, therefore, the 2nd volume of the Russian version of Ritter's Asia ought to be accompanied by copious and well established addenda. Unfortunately all the materials that

might be used for such an amplification are as yet but little digested. The travels of Fëdorof, Kardin, Schrenk, my own, the observations of Golubef, the data collected and elaborated by Fakharof, have not yet appeared in print, and only short notices of them have been presented. I am consequently necessarily obliged to withhold the supplementary matter to the 2nd volume, at all events until the publication of my travels which is now delayed by all my time and attention being engaged on questions of pressing and vital importance to Russia.

With regard to the 3rd volume of the Russian edition of Ritter's Asia, containing a description of the Russian Altai, the not unimportant materials relating to these mountains, which were collected by me on my journey, have been partly digested since my return, and I am therefore in a position to proceed at once with the publication of this volume with its supplementary portion. I think it necessary to allude briefly in this place to some of the general results of my visits to the Celestial mountains. They embrace three questions of the utmost importance to the geography of Asia, namely the height of the snow-line in the Celestial range, the existence of alpine glaciers, and the existence of volcanic phenomena in this region.

On the first of these points I consider it incumbent on myself to dwell at length in reply to the doubts expressed by Humboldt as to the correctness of the elevation of the snow-line in the Celestial range, as determined by me. The height I fixed it at, namely 11,000 to 11,500 feet, was ascertained by Humboldt from a letter I wrote to Ritter, which attracted his particular notice. This letter was published in the "Zeitschrift für Erdkunde" with some explanatory remarks by Humboldt. The method I adopted for ascertaining the height of the snow-line was not known to Humboldt, who grounded his supposition of an over-estimation of the elevation of the snow-line on certain theoretical and analogical considerations.

Inaccuracies in the determination of the height of the snow-line may arise from two sources first from what is taken to be the snow-line, and secondly from an imperfect method of measuring heights.

In the first instance the observer may be deceived either by taking dissolvable for eternal snows, or by fixing their limit of height in

sheltered ravines or defiles which are hardly reached by the rays of the sun. Had I fallen into these errors in my determination the results would have been to lower instead of to raise the height of the snow-line, as compared to its true limits. But these sources of error were fully anticipated and averted; my observations were made at points where regular layers of eternal snow occurred, and moreover on mountain-ridges and not in hollow depressions, in some of which I really did find eternal snows in some cases several hundred feet below the limit of 11,000.

With regard to the other point, I must observe that the method of determining heights by the temperature of boiling water, is certainly one which is far from being perfect; and leads only to approximate results; but the inaccuracy of these results becomes more inappreciable, the greater the height which is being measured. For inconsiderable elevations this method of measurement cannot be adopted. I may, however, observe that the other method, namely that of commercial determination, can scarcely be expected to give more accurate results when the conditions are unfavourable, as for instance on a journey through an extremely wild and dangerous region, where the traveller is obliged to form his own track, and stands every moment in danger of an attack; under such circumstances all simultaneous observations of the barometer, at the base and summit of mountains, or a series of observations at any one point, are quite out of the question. Experience has also shewn me the complete impossibility of keeping the barometers (I had two with me) from breaking, in a country so mountainous as that I traversed, where, on each expedition, the pack horses and camels stumbled repeatedly, and were occasionally dashed to pieces by falling over precipices. Hence travellers (Humboldt amongst the rest on his famous journey in the Andes and the Cordilleras) have invariably had recourse to the method of determining heights by the temperature of boiling water. The results obtained in this manner are regarded by science merely as approximations, until they are superseded* by more accurate data, obtained when the region is more accessible to scientific exploration.

* Although incomplete, these results are nevertheless of undoubted value to science, as the magnitude of probable errors even under such an imperfect method, cannot exceed certain limits.

But Humboldt could not have taken exception to the method used in measuring the height of the snow-line, in the Tian-Shan, because he at that time did not know what means were used for this purpose, and also because he himself adopted the same method on his journey in the New World, which was so prolific of scientific results. Humboldt's doubts respecting the probability of the height of the Tian-Shan snow-line (as fixed by me), being considerable, were based on considerations of comparative geography, and their soundness or otherwise may be easily tested, for they were founded on a comparison of their height of snow-line, 11,000 to 11,500 feet, with its well ascertained limits in nearly the same meridian (in the Altai, 6,600 feet) or in the same parallel, (the Pyrennees, 8,400 feet and the Caucasus, 10,170 feet).

In examining the observations made by any traveller respecting the elevations of the snow-line, the most accurate scientific criticism must test their correctness, by the following theoretical investigations.

The height of the snow-line in a given range, must be calculated theoretically on the basis of a comparison with other ranges, on the same meridian, and the same parallel; the obtained results should then be compared with the figures arrived at by actual observation, and it must then be carefully considered whether the discrepancy that may occur can be at all attributed to considerations of climate, and local peculiarities.

Humboldt, in his classical work "Asie Centrale," supplies us with the requisite figures for arriving at a definite conclusion.

In the same meridian with the Celestial mountains we find that the height of the snow-line is as follows,

In the Altai (Tigerski Belki)
Lat. 51° North, ... 6,600 feet.
On the Northern slope of the Himalayan range,
Lat. 32° North,.............................. 15,600 feet.

The Celestial mountains extend at the part visited by me, between Lat. 41° and 42° North which is consequently mid-way between the Altai and Himalayas. Taking the mean of the figures given above we shall get 11,100 feet for the height of the snow-line of the Celestial

range. In the same zone, parallel with the Celestial mountains the height of the snow-line is as follows:

In the Pyrennees; (between Lat. $42\frac{1}{2}°$ and $43°$ North), ... 8,400 ft.
On mounts Elburuz and Kazbek in the Caucasus ($43°$ N. Lat.) .... 10,170 ft.
On mount Ararat (Lat. $39°$ North), ... 13,300 ft.
In the Rocky mountains of N. America (Lat. $43°$ N.) ...... 11,700 ft.

Humboldt, in his observations on my letter to Ritter, refers exclusively to the Pyrennees and to the Elburuz mountains. With regard to the first they cannot be taken at all into account in determining the height of the snow-line in the Celestial range, as they are situated in a moist sea atmosphere, where the snow-line must be considerably lower than in the continental climate of the interior of Asia. The Caucasus, however, supplies a better point of comparison, if treated with proper discrimination. The height of the snow-line of the Kazbek and Elburuz occurs at 10,170 feet, under a latitude of more than $1\frac{1}{2}°$ to the northward that that of the Tian-Shan, and with a climate considerably more humid. On mount Ararat, where the surrounding atmosphere is drier, and the latitude $2\frac{1}{2}°$ more to the south, we find that the height of the snow-line is 13,300 feet above the level of the sea. If a range of mountains existed between the Elburuz and mount Ararat, under climatic conditions of an intermediate character as compared to those characterising mounts Ararat and Elburuz, and situated under the same parallel as the Celestial range, the height of the snow-line of these mountains would be determinable at 11,300 feet. All these figures, computed theoretically by comparing the heights of the snow-line on different parallels of the same meridian with the Celestial mountains, and on different meridians of the same parallel, coincide very nearly with my determinations. The considerable elevation of the snow-line of the Celestial mountains is to be explained by the peculiarity of their geographical position, and the character of the surrounding atmosphere. It is generally admitted as a fact that a dry atmosphere has the effect of elevating the line of eternal snow very considerably. Thus for instance the snow-line on the southern slope of the Himalayas occurs at 12,180 feet, while on the northern side it rises to 15,600 feet. This anomaly is only to be accounted for by the southern side of the range being exposed to winds

charged with the humid vapours of the Indian Ocean, which settle on the cold mountain slopes in the form of snow, while the winds on the northern slopes of Thibet are completely free from moisture. The extraordinary dryness of the atmosphere of the Celestial mountains, compared to the Altai and Caucasus, is strikingly exemplified by the following instances. In the neighbourhood of Riddersk, in the Altai mountains, the dew falls so heavily that the horseman is completely drenched, when riding through the high grass, while in the sombre forests of the North-Western Altai, called locally Taigi, the atmosphere is still more humid, and rain, during some summers, falls incessantly. Now during the two years I spent in the Celestial mountains and Trans-Ili-Altaü I positively saw no dew; notwithstanding that the summer of 1857 was remarkably wet, and the Altai was rendered impassable from this cause, the fall of rain was very small. In addition, the very vegetation of the Tian-Shan bears evidence to the dryness of the surrounding air.

While the slopes of the Caucasus are clothed with dark and impenetrable forests, which proved so troublesome in the military operations of the Russians, the wooded surfaces of the Tian-Shan are of limited extent, and rhododendrons, which are so widely spread in the moist climates of the southern slope of the Himalayas and of the Caucasus, do not grow at all in the Celestial range.

If to this extraordinary dryness of the air in the Celestial mountains, be added the intense heating of the broad plateau by the scorching rays of the sun, accompanied by cloudless skies and a rare atmosphere, a natural explanation will then be found for the height of the snow-line being at 11,000—11,500 feet. The few measurements of heights made by other travellers in Djungaria, and moreover by other methods, serve to confirm the accuracy of my figures. Fëdorof determined *trigonometrically*, that is by the most accurate process, the altitude of the highest point in the Tarbagatai at about 9,900 feet. The Tarbagatai range extends under Lat. 47° N. and is consequently nearer by 1° of latitude to the Tigeretski Belki, than to the Celestial range. Computing the elevation of the snow-line of the Tarbagatai theoretically, by a comparison of the heights in the Altai and Tian-Shan, we should obtain a result of about 8,600 feet, while in reality the true elevation is considerably greater, as throughout the Tarbagatai range the existing

snows with the exception of two patches, are only sporadic, and the snow-line is not below 9,500 feet. This case proves that the snow-line rises rapidly from the Altai to the Tarbagatai, owing to the greater dryness of a continental atmosphere. Lastly, the barometrical observations of Schrenck, in the Djungarian Alataŭ, in Lat. 45° N., fixed the limits of eternal snows at 10,700 feet. Calculating then the height of the snow-line in the Tian-Shan by a comparison of that of the northern slope of the Himalayan, and of the Tarbagatai ranges, we obtain 11,700 feet and 11,950 feet, if we take in the Djungarian Alataŭ.

In this manner all the facts of the case, not alone those supplied us by comparative geography and climatology, but likewise those derived from the exact observations of other travellers, tend to confirm my figures, and prove them to be rather understated than magnified; Humboldt's doubts therefore as to the possibility of the snow-line of the Tian-Shan exceeding 11,000 feet elevation, are disposed of not only on theoretical considerations, but also by ocular demonstration. The interesting questions relating to the existence of fine alpine glaciers in the Tian-Shan, which is in intimate connection with that of the height of the snow-line, I solved in complete accordance with the previously expressed opinions of Humboldt and Ritter. I set out without any foregone conclusions on this point, but having experienced the remarkable dryness of the air in the Tian-Shan mountains, and having ascertained, on ascending the Faŭkŭ Davan, that the height of the snow-line was higher than 11,000 feet, involuntary doubts entered my mind as to the possibility of the existence of real glaciers in the Tian-Shan. These doubts were, however, soon dispelled. At the sources of the river system of the Sary-Djaza, I came across five magnificent alpine glaciers and a "Mer de glace" exceeding in size that of Chamounix. Notwithstanding some of the peculiarities of the Tian-Shan glaciers, owing principally to their prevalence at not more than about 2,500 feet below the limit of the snow-line, while in Switzerland they descend as low as 5,000 feet, their existence in the form anticipated by Ritter and Humboldt, on the strength of Chinese accounts, was fully confirmed.

It now remained for me to prove, by actual observation on the spot, the existence or otherwise of volcanic phenomena in Djungaria, and

in the Celestial mountains, to which Humboldt in his works so often alludes. I started on my journey firmly persuaded that I should find the conjectured volcanoes, or at all events some volcanic forms, and I sought diligently (as Schrenck did on lake Ala-kul) to establish the correctness of Humboldt's surmises, with respect to the existence of volcanic phenomena in Central Asia, by which confirmation I knew a traveller would gain greater credit than by an incomplete refutation of the hypothesis. I was even aware, that Humboldt was rather displeased with the researches of Schrenk who clearly showed that the island of Aral-Tûbe on lake Ala-kul was not of volcanic origin. The opinions entertained by Humboldt on the subject of the existence of volcanoes in Djungaria were favourite ones with him, and I regret that I was not able to confirm his cherished theory. Kullok peak, another of Humboldt's mistaken volcanoes, was found to have no volcanic origin whatever. The hot springs, and the non-congelation of the waters of lake Issyk-Kul, were not accompanied by any volcanic forms in the Tian-Shan, and furthermore all the native accounts of phenomena which from their descriptions might be supposed to be volcanic, proved unfounded, and were at once disposed of on my examination of the localities where they were declared to occur. The result therefore of my researches on this point was that I became convinced of the complete absence of volcanoes, distinct volcanic phenomena, or even volcanic forms throughout the Celestial mountains. It is true that there existed in Djungaria at one period some " Solfaters" or smoking cavities from which there was a discharge and deposit of sulphur, and that some of these fissures, out of which the Chinese obtain sulphur, emit smoke even at the present day. But a careful inspection of one of the extinguished pits satisfied me, that at all events in *that* case, there was no volcanic affinity.

In the neighbourhood of the pits which I discovered in the Katû mountains, and in the Ili valley, I could trace no volcanic forms, but ironstone occurred, and owed its formation, as far as I could judge, to the pyrites that were widely spread in the vicinity; there was at the same time a discharge of sulphur emitted in the form of vapour out of numerous fissures and which left a deposit on the sides. It is to be taken into consideration that I found a coal formation largely developed throughout the Ili basin, and that coal is obtained by the Chinese in

the neighbourhood of Kuldja, in large quantities, from very deep seams. The whole process of the formation of sulphur can then in my opinion be reasonably explained by the combustion of some coal seams in this basin, which would at once set at rest the question of supposed volcanic agency.

I cannot positively affirm that the origin of the other smoking pits of Djungaria, and particularly Humboldt's famous "Solfater" of Urumchi, is susceptible of the same explanation, although the analogy between all the Djungarian "Solfaters" would appear to be confirmed, native accounts excepted, by the circumstance that the Chinese, who are very expert in recognising such sulphur formations, procure sulphur from the "Solfaters" of Katü which I visited.

With still less certainty can I deny the existence of volcanic phenomena or volcanic forms farther eastwards in the Celestial mountains. Humboldt in his observations on the letter I addressed to Ritter, which was published in the "Zeitschrift für Erdkunde" says that the Sangai, rising in the centre of the Ando-Cordilleras range, the most active of all the volcanoes in the world, forms around itself an island of trachyte, not more than two geographical miles in diameter. From this I must of course conclude that the observation of a single portion of the Tian-Shan visited by me cannot serve as a positive evidence of the absence of volcanoes and volcanic forms in other parts of this mountain system. My conclusions on this question generally have already been made public, in the letter here referred to, but I must likewise observe in addition, that all Asiatic accounts of phenomena which might be volcanic in appearance, should be treated by men of science with great circumspection, as many of these accounts have already proved fallacious. I would here also remark that the impression produced on me personally by Djungaria and the Tian-Shan leaves great doubts in my mind as to the existence of volcanoes in this part of Asia, and as I am the only traveller who has visited the Tian-Shan, I cannot accept the belief in their existence, as an axiom requiring no proof or confirmation.

My conclusion on this point, though negative, is one of the most important results of my journey.

If, in aspiring after the truth, I have been compelled to express opinions on two points of such vast importance to the geography of

Asia, which differ completely from those entertained by Humboldt; whose faith in the existence of volcanoes in the Celestial mountains was as firm as that of Columbus in the existence of the New World, it does not necessarily follow that I cast a shade (in itself impossible) on the spirit of the great scientific genius of the age. Science is the eternal aspiration of the whole human race towards truth, and truth can only be grasped at out of a multitude of errors and misconceptions. No one moreover is more liable to fall into such errors than the pioneers of thought, who marshal their fellow creatures to the great goal of truth, and call into existence words of new thoughts and conceptions.

These giant minds are followed by a train of disciples, for whom the path of investigation, and the final solution of great scientific problems, is rendered comparatively easy. Thus there are the men of genius in science, or the master minds, who conceive great thoughts, and the workmen who follow up such of these thoughts as are susceptible of elaboration. Each has his separate functions, but on the most humble labourer in the field of science devolves the sacred duty of pointing out and rectifying any error into which the eminent master may have fallen. And in such a case, the obscure advocate of truth should not be crushed by all the height and authority of genius, science being a problem open to solution to all humanity, and recognising no individuality or oligarchical superiority. The science of geography has lately been deprived of two of its most brilliant leaders—Humboldt and Ritter. To follow in their footsteps, to extend the circle of their researches, to strive after that eternal truth which they eagerly sought during their mortal careers, to correct the few errors which are interspersed through the wide field of their enquiries, these are the duties of every votary of science, even of the most humble grade, and will serve as the best testimony of admiration and respect to our great masters. May the present effort be taken as such an expression, and as one of the many proofs, that dying, Humboldt and Ritter have bequeathed to humanity a living record of their great genius.

Notes of a trip up the Salween—*By Rev.* C. PARISH.

[Received 30th June, 1865.]

In March last, as I had never travelled on the Martaban side of the Salween, and as I had been promised by Captain Harrison, the Deputy Commissioner of Shway-gyeen, that, if I would pay him a visit, he would accompany me through the Fir forests of the Yoonzalin, which I have long wished to see; I availed myself of a month's privilege leave to take a trip northwards. Col. Fytche was going, at the same time, on his official tour to Shway-gyeen. His company was an additional inducement to go in that direction.

The road to Shway-gyeen lies through Beling and Sittoung, and affords good riding ground all the way in the dry season, as it keeps to the plain, leaving the mountains on the right hand, that is, on the east. These mountains, which, N. E. of Shway-gyeen, cover a great breadth of country, divide themselves towards the south into two narrow ranges, one of which separates the Yoonzalin and Salween rivers, terminating at their point of confluence: the other and longer range terminates at Martaban, and is the watershed between the Sittoung and Beling rivers on the west, and the lower Salween on the east. Westward of the latter range stretches a vast plain; and it is along this plain, parallel with the mountains, though at some little distance from them, that the road from Martaban to Shway-gyeen lies.

While at Beling, on the way, I rode out in company with Col. Fytche and Capt. Harrison to a place called *Kothanaiong*, about 7 miles off, to see the Amherstia trees there. This place had often been mentioned as one where the Amherstia was to be seen in great perfection, and where, indeed, it might perhaps be wild. I was well rewarded, for a prettier little spot I never visited. The Amherstias, growing in a well-shaded place and watered by a perennial stream which tumbles down a steep granite hill, and is ingeniously directed hither and thither in large bamboo troughs, were, indeed, to be seen in the wildest luxuriance of growth. But *Kothanaiong* is a sacred spot. Here are Pagodas, Pongyee-houses, Zayats all around. A flight of stone steps leads from the bottom to the top of the overhanging

hill, which is about 600 feet high, and on which are more sacred buildings. The Amherstias, seen only round the principal Pagoda, were undoubtedly planted, although they are left now to take care of themselves, and have a wild appearance. Evidently, this is not a native habitat of the tree.

From Beling we went on to a place called *Kyik-hto.* Eastward of this place and distant about 14 miles, is a remarkable mountain, called *Kyik-hteo.* Capt. Harrison, one of the very few Europeans who had been there, assured me that it was well worth a visit, as there was, on the summit, a very singular hanging rock, surmounted by a Pagoda. We went accordingly, riding the 14 miles to the foot of the mountain in the morning, and walking up it in the middle of the day. We reached the top 3,650 feet at 3.30 P. M. The view from the summit is very fine, as all views from great heights are; but the many granite boulders which are scattered about, some of them perched and balanced in the strangest manner on the most prominent peaks, constitute the most remarkable feature of this mountain. On all the most striking of these boulders small Pagodas have been built; in several instances, I should say, at the extreme risk of life to the builders. As the only way of conveying a true idea of the appearance of these rocks, I send a rough sketch of two or three of them.

There are two principal ones.—The one at the very summit is called Kyik-hteo "*par excellence;*" the other, some little way down the hill is, *Kyik-hteo galay,* or, "*little Kyik-hteo.*" We could not ascertain for certain what their names signify, further than that "*Kyik*" is "rock" or "mountain-peak." I have observed that the Burmese never know the meaning of the names which the mountains and prominent rocks in the country bear; the names being older than the Burman occupation of it. They are, I believe, generally *Talaing,* but sometimes *Karen.* The chief rock of all, which gives the name to the mountain, is simply a wonder. It is a huge rounded granite boulder perched on a projecting and shelving tabular rock at the very summit. This tabular rock is itself reached by a small foot-bridge, for it is separated by several feet from the mountain by a rent or chasm; and on the farther side it drops down perpendicularly, I do not know how many hundred feet, into a valley below. On the extreme verge of this flat sloping rock-table, and actually over-

hanging it by nearly half, is perched this wonderful boulder, which is, about 30 feet high, and is surmounted by a small Pagoda about 15 feet high. A rude bamboo ladder is leant against it on the inside, which enables an adventurous person to ascend. Every native will do this, but we, being both heavier and more awkward, preferred to remain at the bottom.

Viewed on one side, it is difficult to understand why this rock does not slide off its shelving support into the valley below! As one looks at it, it appears as if, assisted with a little grease and a slight push, it *must* go! But there it hangs, as it had hung, and I suppose, will hang yet,—one might indeed almost say, there it *slides* and will *slide*,—for many an age: "Labitur et labetur in omne volubilis ævum;" unless some earthquake (and a very slight one surely would do it) should rudely shake it from its precarious foundation. This place is annually visited for the purpose of worship by people from all parts of the country round; many, I am informed, going to it even from Moulmein. Many were already there, and very many more shortly expected, as was shewn by the temporary booths of grass which had been erected, and were calculated to hold several thousand people. Altogether, this is a remarkable place, very little known, and well worthy of the trouble of visiting it from a long distance.

I was disappointed, however, here, in a botanical point of view. I expected great things from a high mountain in a totally new part of the country; but I gathered scarcely anything. There were no Orchids at all. The Ferns, if any, were dried up; one or two new Acanthaceous plants alone rewarded my search. At this season the mountain is arid, and vegetation on it scanty. On the top there is little else besides long grass.

We passed the night on the top; and descended on the opposite, or north side the next morning. Our ponies had been sent round, and were found waiting for us at the appointed place; and a ride of 18 miles brought us by evening into Sittoung. From Sittoung to Shway-gyeen the distance is about 40 miles. After two or three days spent at Shway-gyeen in making preparation, Capt. Harrison and I started upon our walking trip to the Yoonzalin district.

The Yoonzalin river is a tributary of the Salween and takes its rise in (about) Lat. 18° 30′ and flows in a very tortuous course, but in

a general southerly direction until it joins the Salween at Kankareet, a little below the Hat-gyee. It drains a very mountainous district, and during the rainy season, rolls down a considerable body of water, but during the dry weather, it is a shallow rocky stream, full of rapids and scours. It takes small boats 15 or 20 days to ascend from Kankareet to Pahpoon, about two-thirds of its course. It took us 5 days to descend that distance.

The valley of the Yoonzalin is an extremely wild and almost uninhabited district. All the way from Bangatah in the valley of the Sittoung to Panpoon we did not meet with a single village. The Karens, the only inhabitants, are very few and scattered; and they have been so harried during the last few years, by the incursions of the Shan Pretender who styled himself *Ming-loung*, on the one side; and by us, in our attempts to drive him out, on the other, that they have hidden themselves away in the most inaccessible places. Occasionally only we saw a stray house or two perched up on the top of some distant mountain, or on its almost perpendicular side, with no visible way of approach from the spot where we stood. When the inhabitants become reassured and gain confidence in the permanency of peace, they will no doubt increase, and settle down in more accessible places.

I will not attempt any description of the scenery of this district, because mountain scenery in one place is very like mountain scenery in another place; and because I have rarely found that attempted descriptions of the kind convey any definite picture to the mind. All that needs be said is, that it was extremely wild and beautiful, and afforded all that endless variety of view which a chaos of mountains rudely thrown together, might be expected to afford. Neither shall I give the length of the stages which we performed, nor the names of the places where we halted; for these places were not villages, only well known spots conveniently chosen for the purpose, as combining the advantages of level ground and water. And the stages, if measured by miles, might appear small; though measured by labour, by no means so. A more laborious, at the same time thoroughly enjoyable, walking tour I never took. It is ceaseless ascent and descent, to the extent of several thousand feet a day, all the way. There are two words in Burmese for hill: *Toung*, and *Kŏn*. A *Toung*, hereabouts, is

a good stiff hill, in fact, a regular mountain. The word *Kŏn* seemed to be applied to any thing under 1000 feet. Two or three *Kŏns* go for nothing, no account is taken of them in the prospective march, if you should ask what it is like. After two or three days, one learnt oneself to despise a *mound* of 1000 feet. In this sort of travelling, one counts hours not miles; and, beginning to walk at 5.30 or 6 A. M., a man has generally had enough of it by 11 or 12 o'clock, and rejoices to hear that the "*tsikan*" or halting-place is near at hand. And this is the country through which some enterprising person has, I believe, proposed to make a Railroad to China!

The extremely low temperature of the upper part of the Yoonzalin district is remarkable. Immediately you get in among the mountains, even before crossing the watershed which divides the Sittoung and Yoonzalin, it becomes very much colder. It was the beginning of March; yet, at a place called Thayet-penkindat, on the west of the watershed, the nights and mornings were uncomfortably cold, and the water in the stream excessively so. Before reaching this place, an elevation of at least 4,000 feet, has to be made from Bangatah. Thayet-penkindat is the name given to a stockade which we have placed here. It is beautifully situated at the head of a fine valley, and is 2206 feet above the sea, and closely surrounded by mountains 2000 or 3000 feet higher. The stockade is guarded by a Police force, and the site appears to be well chosen, as it is situated at the entrance of the Pass into this part of the Yoonzalin. This Pass is called *Kyouk-taga* or *Rock-gate*, and is a narrow defile, two or three miles long. The head of this pass is 3343 feet above the sea.* A small stream runs through it, and the vegetation consequently is very rank. I was told that I should probably find some new ferns here, but though there were many species, there was nothing which I had not seen before. Near the head of the pass, however, I discovered a new species of Bulbophyllum, and one or two other orchids.

Through this pass, we were in the Yoonzalin district, and, to my great delight, the next day, among the Fir trees. The sight and the fragrance of a Fir forest to me, who had not seen one for a long time, was most refreshing. The trees are all of one kind, *Pinus longifolia*,

* The heights given have been furnished by Col. Blake, and are from his own measurements by an aneroid.

and cover the mountains from top to bottom. In many places it is the only tree visible. It attains a considerable height, 80 to 100 feet, and are, (the full grown ones) 8 to 9 feet in girth. The temperature of the tract or belt of country where the Fir grows, as, I said just now, is extremely low. In the month of January, Capt. Harrison informs me, (for he had been here in that month) there is hoar frost, and a thin covering of ice forms on a basin of water by the morning. Even in March we found the nights and mornings so cold, that we were glad of thick over-coats and a blazing fire of Pine logs. At 11 and 12 o'clock in the day, and while walking in the sun, the heat was not unpleasant. The vegetation gave indications of low temperature. I gathered violets in the valleys. *Rubus* was met with; and instead of the *Acanthaceæ* and *Zingiberaceæ*, which cover the hills to the south but which were not seen here at all, *Compositæ* (among them a large *Carduus*) abounded; many of them attaining to the dimension of large shrubs. The *Compositæ*, however, were not confined to the Fir tract. Of Epiphytic *Orchideæ*, there were none: though I dare say that, in the rainy season, the terrestrial kinds would be numerous. As the forests were dry, ferns were scarce, though I was gratified at finding that singular little tree fern "*Brainea insignis*" in large quantities. I had never met with it before. I gathered also *Adiantum flabellulatum* and *Lindsæa tenuifolia.*

Immediately we crossed the watershed to the eastward, though still among the mountains, the Fir trees ceased, and it became very hot; and so it continued when we turned southward and crossed again into the Yoonzalin valley. It is only in the upper Yoonzalin that the temperature is so remarkably low, and that the Fir forests exist. Strange, however, to say, the Fir reappears in the Tenasserim provinces at Myawaddee, on the Thoung-yeen, some 50 miles due east of Moulmein, and thence stretches southwards for several miles, as I have myself seen. The tree there does not form forests, but is sparsely scattered among other trees; nor does it grow so large. But, and this is most remarkable, in the Thoung-yeen valley, it is found on hills only about 1000 or 1500 feet high, and descends nearly to the river; therefore in many places, cannot be more than 300 or 400 feet above the level of the sea; and this in N. Lat. 16.° !

Shortly after passing out of the Fir forests I was delighted to come

upon a truly splendid Bauhinia, which I discovered for the first time last year in the Thoung-yeen valley. Then, however, I met with but one tree—here now I found many, and all in flower. The flowers are very large, about 4 inches in diameter, of the purest white, save the single coloured petal which is streaked with purple and gold. It far surpasses *B. Richardiana* in beauty, for the petals of that plant are very narrow, consequently the flower looks poor, whereas, those of the species I am describing, are broad and meet at their margins, and this adds immensely to its beauty. The flowers also are of the sweetest fragrance, and are produced in profuse abundance all over the tree. I hope to get seeds of it. I left particular instructions with the head-man of that part of the district, to gather some when ripe and forward them to Capt. Harrison, who kindly promised to remember me in the matter.

The most northerly point to which we went was *Kanlado*, another police station, and our frontier out-post. It is but some 15 miles from our boundary on the North, and not far from the Salween. There is a strong block-house here besides a stockade. It is situated on the top of a small cleared hill, and 1881 feet above the sea; it is surrounded on all sides by higher hills. This is the lively abode of the officer who has the honour of serving Her Majesty in the capacity of Assistant Commissioner of the Yoonzalin district. He, at least, if no one else, will rejoice at the completion of the projected Railway; but he is likely to be the only passenger!

The vegetation of the hills round Kanlado is very different from that which is seen in the Tenasserim Provinces. The forests consist almost wholly of what the Burmese call *Engyen* a species of *Shorea*, a middle-sized tree, at this season of the year in flower and without a leaf. The forests consequently have a bare wintry look, a condition of jungle never seen in the Tenasserim Provinces, where the whole country is densely green throughout the year. There are, of course, a few other trees mixed with the *Shorea*, such as *Careya*, *Dillenia*, *Eugenia*, and *Anneslea fragrans*; but not in sufficient quantities to alter the character of the jungle which is given by the prevailing *Shorea*. Orchids grow sparingly on the trees here, but some good kinds; *Dendrobium Dalhousianum*, *formosum*, and *eburneum*. The only other locality known for the last plant is the valley of the Shoung-

yeen. Besides these, I collected two or three other species familiar to me, but not yet described or named. There was nothing absolutely new to me here; indeed, the whole expedition only yielded two new Orchideæ; the *Bulbophyllum* already mentioned as found in the *Kyouk-taga;* and a *Dendrobium* with the flowers of *D. aggregatum*, but with short, erect cylindrical pseudo-bulbs.

From *Kanlado*, after a day's halt, we bent our steps southwards and homewards; as my limited time would not allow me to go further, not even to visit the banks of the *Salween* which is within an easy day's march of *Kanlado* on the east. About half way between *Kanlado* and *Pahpoon*, we turned aside from our path to visit a waterfall on the Yoonzalin river. I had often noticed on a map made by a local surveyor, professing to be a map of this district, high up on this river, the words, "*Waterfall*, 400 *feet;*" but I could never find any one who had seen the waterfall. Now, a waterfall of 400 feet is a very unusual feature in the scenery of any country and a grand sight; and I had long formed a secret resolution to find out this waterfall some day, and verify the statement as to its height. We were now at the very part of the country whence, if visited at all, it must be visited. I determined, therefore, not to return home without seeing it. Capt. Harrison, happily, was of the same mind; so, notwithstanding the assurance of the natives that the place was very difficult of access, and the mountain side very steep and slippery, we sent on a party in advance to find out a way for us and to clear the jungle sufficiently to make it passable. Arrived at the point of our road whence it was necessary to diverge from it to go in search of the waterfall, we struck off, and had certainly as hard a morning's work before we reached the object of our search, as any man could desire: but we reached it about noon, and that was enough.

On arrival we were at once gratified and disappointed: gratified at finding ourselves in a most romantic spot, and at the preparation made for us: disappointed at seeing no waterfall, although we were told that all that was to be seen lay before us.

We had come prepared to rough it and sleep on the ground; we were, therefore, agreeably surprised at finding a very capacious and exceedingly pretty structure built, and all ready for us. The site was selected with great taste, for on stepping up out of the thick jungle

by a small ladder, on to our house, and on going to the front of a broad balcony or verandah ornamented with a balustrade, the whole made of bamboo, we found that the boughs of the trees had been cut away in front, and that we stood over a large circular pool of water into which the Yoonzalin poured itself on one side, and out of which it flowed on the other, and we had the best view that it was possible to have. We were in a perfect punch-bowl, shut in by almost perpendicular mountains on all sides. Before us lay the still pool, 60 feet deep and about 150 yards across: we heard the roar of the water rushing in and rushing out, but, so hemmed in with rocks is the spot that we could neither see the course of the river above or below. As I said, we were charmed with the place, but where was the waterfall of 400 feet? The reply was, that this was the "*Yaytagon*" (so the Burmese call a waterfall) and that there was nothing more to be seen than this! A raft of bamboos was made for us, and on it we went close up to the "*embouchure*" of the stream, the mouth of the passage through which the water from above pours into the pool. It was a singular sight. The whole of the waters of the Yoonzalin at this point are poured through a long, straight, and very narrow *street* of rock. The passage, or *street* as I call it, through the rock is *perfectly* straight, about 14 feet wide only, and having exactly the same width throughout its whole length, which is about 20 or 30 yards. The rock, granite, rises on either side of this passage to the height, in the centre, of about 50 feet in perpendicular walls with smooth faces, as straight and smooth as if measured with a plumb line, and cut with a hay-knife. As the water enters the upper end of this passage at a right angle, we could see no more of the river than the length of the passage, but we could hear the roar of the water as it boiled and bubbled in its tortuous and bouldered channel above. But though lashed into foam above, so smooth and polished is the narrow passage that the water glides through it with a surface like glass, and sinks at once to the bottom of the pool, causing little or no commotion in it. I climbed to the top of the overhanging rock on one side to get a sight of the river above, but it takes so many short and sudden turns and the gorge in the mountains is so narrow, that I could see but a few yards upwards. Thinking that we had seen all that was to be seen, and having already spent a day and a half here, we determined to set out

on our return the next morning; but towards evening, some of our party, who had been exploring, came and informed us that they had discovered a way to get up the rocks on the opposite side, and that having ascended that way they had come upon a waterfall. As we wished not to leave the place without being able to speak positively on the subject of the fall, and thinking that there might yet be one higher up the stream but hid from our view, we resolved to stop another day, and explore on the morrow. We did so, and climbed the way pointed out to us; and thus, taking the passage before mentioned in the rear, we got a good view of the river for a mile or so above it. As far as the eye could see, the course of the river lay through an extremely narrow valley and was impeded the whole way by huge granite boulders. The fall of level also was considerable; and near the spot where we stood, it took a sudden perpendicular leap of some 30 feet, into a deep and very confined square hole, which at once turned the water at a right angle, whence it rushed on, and after 2 or 3 similar sharp turns within the length of a hundred yards, dashed through the beforementioned passage into the pool. We had now seen all certainly and could positively assert that the greatest perpendicular fall the Yoonzalin makes here, is not more than 30 feet. Though disappointed of a *grand* sight, we yet considered ourselves well repaid for our toil by the general beauty of the spot and by the very remarkable character of that natural feature in the scenery which I have attempted to describe; the narrow street with perpendicular walls through which the whole river, as well when at its height in the rainy season, as in dry weather, has to make its way. Several persons have thought that Pine logs might, in the rains, be floated down this river to Moulmein: but no one who had visited the Yay-tagon would allow it to be possible. No log could, I am convinced, pass this part of the river's course without being broken to pieces. It is unfortunate that all the Pine forests should be above the fall.

There was one drawback to our full enjoyment at this place. There is a pest here in the shape of a very small fly, met with happily no where else, which attacks every exposed part of the body most virulently. Its puncture immediately raises a blood pustule and causes considerable irritation for several days afterwards. I could scarcely sketch for these tormentors; and when we bathed, especially, their

attacks were so vigorous, that we wasted no unnecessary time in putting off and in resuming our garments. On the third day after our arrival we started for "*Pahpoon.*" It was not far from "*Pahpoon*" that, for the first time in the whole journey, we heard the cry of the Gibbon. Its cry was totally different from that of the Gibbon of the Tenasserim Provinces. The latter is a wailing, plaintive, and, to me, not disagreeable cry: but the cries of the Gibbon here were most discordant, and not unlike that of a pack of jackals. They can hardly be the same species.

From Pahpoon, an obscure village on the Yoonzalin, we dropped down to Moulmein in boats. On the second day after leaving Pahpoon I noticed unexpectedly on the bank of the river, in one of the wildest spots, a fine *Amherstia* in full flower, about 30 feet high. I saw but one; for it was the middle of the day and hot; I had been, therefore lying down in the boat under cover, heedless of what I passed. I looked out of the boat casually, and saw this tree; so there *may* have been others which I did not see, both on the bank and in the adjacent jungle. I am sorry to say that my companion Capt. Harrison was a long way behind in another boat, so that I could not point it out to him; and he did not notice it, because, not caring for the character of the vegetation, he did not look out from his boat at all.

Now, my reasons for saying that this was a bonâ fide wild tree are these: in all this district, the valley of the Yoonzalin,—there are no Pagodas or Pon-gyee houses, or spots sacred to the Burmese where they have erected buildings. The inhabitants of the district, in fact, are Karens and not Burmese; and these Karens are exceedingly few and scattered. After leaving Pahpoon, we did not see a single village on the banks all the way until we came to the junction of the Yoonzalin with the Salween. There are, indeed, no doubt, a few villages a little way from the bank, here and there hidden among the trees, but these generally consist of but 2 or 3 houses: neither are they settled villages, for the custom of the Karens is to change the site of their houses continually. Besides the regular Karens, not being Buddhists, do not build Pagodas, nor do they ever trouble themselves to plant ornamental trees, as the Burmese always do in their sacred places. Besides, the spot where this Amherstia was seen, was not at all a likely place for an Amherstia to have been planted by *any one*; *but*

one of the wildest places imaginable. Had it been on a rising ground on a high bank alone, or on any prominent point on the river, I should have suspected that a hand had planted it : but it was on a low and sloping part of the bank, struggling for life with *Calamus*, *Bauhinia* and tall grasses and such other tangled stuff as forms the common vegetation of our river banks in the wildest places; and behind again was dense jungle of the tallest trees. However, notwithstanding all this, had it been seen in a fairly peopled district, I should have doubted; but in such a wild uninhabited country as the Yoonzalin is, I see no reason for suspecting that it was not a genuine native.* Had Wallich's first tree been here, I am satisfied that the idea of its *not* being wild would never for a moment have occurred to him. I am perfectly satisfied that the tree seen by me was a wild one. That the Amherstia in a wild state may be very scarce is not improbable, but that it should not exist any longer in that state, though possible, is, to say the least, very unlikely. Probably it is confined to a small area; and I am inclined to think still, as I always have thought, that its habitat is the banks of the Salween, and of the Yoonzalin, which runs nearly parallel with the Salween in about the latitude where I suppose it grows. Very few Europeans, who would care to notice the vegetation of the country, have ascended either the Yoonzalin, or the Salween above the Great Rapid, that is to say, have been continuously along its banks, so that a rare tree may, not improbably, exist there, although it has not been seen on the latter river at all, nor on the former, except by myself, as I have described.

I append a rough but tolerably accurate map of the country.

* The *Amherstia* has never been found wild before. Wallich discovered it, i. e. first saw it, at a place called *Pagât*, some twenty or thirty miles up the Salween. The trees which he saw are still there, at least some of them, and are manifestly planted trees, being near an artificial tank, at the entrance to some sacred caves.

I have long had an idea that the native habitat of the *Amherstia* would be found to be somewhere high up the Salween. This is not at all unlikely, because very little, indeed almost nothing, is known of the banks of this river above the *Hât-gyee*, or *Great Rapid*, which is about 100 miles up the river.

Notes of Observations on the Boksas of the Bijnour District.—*By Dr.* J. L. Stewart.

[Received 10th January, 1865.]

Travellers in Central America tell us that the phrase *quien sabe* ("who knows?") stops them at every step, when they seek to inquire into the past history of the natives, and some analogous expression is probably in frequent use, in similar circumstances, among all barbarous or half-civilized races who have no literature. In this country *quien sabe* is fully represented by *khabar nahin* and *Khuda jáne*, and of these I have had much more than was pleasant, in trying to discover something of the past history of the Boksas of the Bijnour district. My attention was first directed to the existence and peculiarities of these people, while making some investigations as to the food of the inhabitants of the district, and various circumstances subsequently led me to be somewhat curious about them. And although I have miserably failed in making out anything definite as to whence the Boksas came or from whom they sprung, a few facts have been elicited regarding the habits, mode of life and health of those who inhabit the Bijnour Forest and the Patli Doon, which may have some interest as relating to a section of this tribe, the last of which, it seems not unlikely, will be seen by a few more generations.

This information was only acquired by a good deal of patient digging among these Boksas themselves, during several weeks of the cold season of 1862-63 when I visited a considerable number of their villages, and conversed with many of their inhabitants, including some of the most intelligent headmen among them.

No detailed description of the Boksas, or of any section of them, has hitherto been published, but there are many scattered notices of those who inhabit the eastern portion of the Rohilkhund forests, in the reports and papers of Traill, Batten, Jones and Madden; and Sir H. M. Elliot, in his supplement to the Glossary, gives some interesting traditions as to their origin. Frequent reference will be made to these notices hereafter, but, meantime, a few general facts gleaned from these and other sources may be given regarding the distribution and characteristics of the eastern Boksas. Since our occupation of

Rohilkhund they would appear not to have extended in any numbers to the eastward of Kilpoory, beyond which the Tharoos, a similar race begin to prevail, and their chief settlements were near Guddurpoor and Roodurpoor. On the rearrangement of the canal system of that part of the Rohilkhund Taráí, the Boksas were concentrated to the north of Guddurpoor, where their settlement is now known by the name of Boksár. Nearly 300 years ago this term was applied to a tract a little further to the eastward, in which, at that time, probably the greater number of the tribe resided. Captain Jones, about 1815, gave the number of inhabitants of (the present) Boksár as 2,293, and I have no information, subsequent to that date, shewing what proportion of the Boksas of the neighbourhood may still inhabit scattered villages.

The Boksas inhabiting the forest to the east of the Ramgunga, who are called by those of Bijnour *Púrbiá Boksas*, and sometimes *Khalsí*, are described as mild, inoffensive and truthful, but indolent, fickle and unthrifty, and extremely ignorant; and, ere they were taken in hand by British officers, they are said to have been kept in grinding poverty by the usurers and their own Pudhán. They are stated also to have shewn an invincible disinclination to settle down for more than two years on one spot, yet never to emigrate outside of the Forest and Taráí, to be excessively partial to the flesh of game, especially wild pigs, and to exhibit a "wonderful immunity from the effects of malaria."

The Tharoos or Tharwi above alluded to, present many points of resemblance to the Boksas, though neither will acknowledge any connection with the other. But the former cover a much greater extent of country than the latter, as from the point a little west of the Sardah where the two tribes dovetail, the settlements of the Tharoos stretch eastward through the forests of northern Oudh and Goruckpore to the river Gunduck.

I can find no evidence that on the east the Tharoos meet the Meches, who are called by Dr. Hooker "decidedly Indo-Chinese," and who occupy a similar position abreast of Darjeeling, to that held by Tharoos and Boksas to the west, and to whom they appear to possess a considerable resemblance.

The fact of different segments of the Sub-Siwalik forest being

inhabited by three tribes which acknowledge no relationship, and which, at the same time, have many peculiarities in common, is deserving of more attention than it appears to have hitherto attracted.

To the westward of the Ganges, there are some Boksa villages inside the Siwaliks, in the Dehra Doon, but I can discover nothing certain regarding their numbers, nor as to whether any of the tribe inhabit the forest outside the Siwáliks in the Saharunpore district. These western Boksas are called by those of Bijnour, *Mehras* or *Meri*, and are acknowledged by them as in every respect of the same caste with themselves. But isolated statements by members of such ignorant tribes can hardly be accepted without check, for the Pátlí Doon Boksas repudiated all *barádárí* with the *Meri*, as well as with the *Párbiá*, whom they asserted to be nothing but Tharwí, and to eat frogs and lizards.

We need not, however, suppose *their* ignorance to be strikingly exceptional, for, at an early period of my inquiries, I was informed, upon what would ordinarily be called "good authority" in the Bijnour district, that the Boksas were chiefly remarkable for living in houses built on poles, for the indifference of their women to decent clothing, and for mainly earning a livelihood by gold-washing. As will be seen by and bye, there is some little truth in the last statement, while the two first are baseless. But this is beaten by the characteristics attributed to the Boksas of Dehra Doon by the other inhabitants of the district, who say that the former are famous for dealings in witchcraft, for successful treatment of insanity and syphilis, and for their pot-bellies, all which peculiarities probably originate in the imagination of the narrators.

The number of inhabited Boksa villages in the Bijnour district outside the Siwáliks, including two in the Patli Doon within the outer hills, is fifteen, of which the thirteen outside are pretty equally distributed over the Forest, but are rather more numerous towards its western end. Of these, four are situated near the base of the Siwáliks on the inner edge of the Forest, five on canals at some distance from either border of the latter, and four—all in the eastern part—on or near its outer edge in the Tarái proper. It is out of my power to give aught like a correct census of these, but the number of inhabitants in single villages, ranges

from twenty to at least two or three hundred in one or two of them. Having found out the exact number of persons in a few families, and made a good many inquiries, about most of the villages, bearing on the point of population, I should put down the total number of Boksas in this tract as at least two thousand, and possibly nearer three thousand.

Of the fifteen villages, eleven were visited. All are built on the same plan of one straight street generally of considerable width (in some cases as much as forty to fifty feet) and kept very clean, in both respects, differing remarkably from the ordinary villages of the plains. The huts are placed end to end with intervals after every group of three or four, and the walls are, for the most part, built of wattle (of split bamboo) and dab, but sometimes of *chhuppar*, of which latter the roofs also are constructed. The houses are windowless, but each has a door in front and another behind, the latter affording access to the sheds for cattle, &c. The doorways and roofs are very low, and the floors of beaten earth are considerably raised above the general level of the ground, and are kept scrupulously clean. The only "furniture" in the houses, besides an occasional *charpái*, or more frequently small *chhappars* (which are often used to sleep on, as cheaper than the former), consists of a few cooking vessels and one or two barrel-shaped utensils three or four feet high and fully as much round, made of wattle and dab, and used for storing grain.

There is no change made in the houses or household arrangements during the rains, so that these western Boksas do not at any time "live in houses built on poles," as is stated to be the case with those opposite Kumaon.

The members of the tribe are of short stature and very spare in habit, in both respects, somewhat exceeding the ordinary Hindoo peasant of the district, from whom, however, they do not differ much in general build or in complexion. No measurements of their crania were made, but so far as ordinary inspection goes, their features are marked by several of the Turanian peculiarities. Thus, the eyes are small, the opening of the eyelids being narrow, linear and horizontal (the inner angle not inclined downwards so far as I observed), the face is very broad across the cheekbones, and the nose is depressed, thus increasing the apparent flatness of the face, the jaw is

prognathous and the lower lip thick, and the moustache and beard are *very* scanty. Some of these peculiarities are much more marked in certain individuals than in others, but most of them were noticeable in almost every man's face I saw, and it seems certain that a Boksa will at once recognize another to belong to his tribe even if he never saw him before, although some persons (Kumaonis) said they could not recognize one of the tribe until he *spoke*.

The features of the few women that I had an opportunity of seeing closely, were comely enough and of the same general character as those of the men; but, as might be expected, in the children of both sexes and even in a descendant the above peculiarities were but little noticeable. Indeed, some lads were remarked in whose features could be discovered no difference from those of the ordinary peasant of the district. I cannot say, whether or not, it was owing to the Boksa peculiarities of feature striking one less after a time, but in the western part of the forest, which was visited last, "features hardly so marked here" are noted more than once.

As will be seen presently, I am inclined to lay considerable stress on the fact of the Boksas having features with so many points of resemblance to the Turanian type so well-marked, that they have in a general way been commented on by all previous observers.

The dress of the men is the same as that of the ordinary native of the North West Provinces, but, except in one or two cases where the Pudhán may be presumed to have put on his "Sunday clothes" for inspection, none of them wore turbans over the thin cotton cap which generally covers the head. The little boys run about *in puris*, or nearly so, the girls wear a scanty rag. The women's dress consists of a petticoat, generally blue or of an orange-red, with a dirty-white or orange-red *chaddar*.

The proper names, in use by the Boksas, are almost always the same as those of Hindoos generally, with a few exceptions such as *Pálú*, *Dhanni*, *Mangú* and *Kakha*, which may be supposed to have been corrupted from Hindoo names. All of those, who were questioned on the subject, were quite positive that their language is quite the same as that of the other inhabitants of the district, and I heard of no words peculiar to these people, with the exception of some names of trees. The most remarkable of these is *Kandár* for the *Sal* tree,

which, however, was only heard locally. Singular enough, the Tharoos as Madden mentions, apply a special name *Koron,* to that tree. But little stress, however, can be laid on any, specially in the names of plants, which, with the natives of other parts of India, are often found to alter within a few miles, even among the same or closely allied tribes.

There are some peculiarities in the *boli* of the Boksas by which one of them is at once recognized by members of their own or other tribes. Thus *n* is constantly substituted for *l*, as *sán* for *sál* and *nath* for *lath*, and less frequently changed into *r*, and *n* into *l*, as *dári* for *dáli* and *thalela* for *thanela*. Two of these changes are often met together, as *Baglana*, which is very often substituted for *Bagnala*, the name of their chief village. One is struck also by a dialectic manner of pronunciation, which alters the short *a*, and occasionally the long *a* of Hindustani, into a sound approaching that of the French *eu*. Thus, Boksa is called Boksuh, and *achha súkha rahtá hai* is pronounced *achhuh súkhuh rahtuh hai.*

The earliest historical indication of the existence of the Boksas consists in the circumstance of a certain division of the Chourássi Mull in Rohilkhund, nearly 300 years ago, having been called *Boksár*, a term which is now, as then, applied to a tract of country thickly inhabited by them (as well as to the tribe, and sometimes to a single village of the *Boksas*). With regard to the traditional origin of the race, the clear and connected statements given by Elliot and Batten on this head are by no means borne out by the discrepant and, in some cases, absurd scraps of information which only these western Boksas, and the three *purohits* who are their spiritual guides, can impart. The writers mentioned, state that the traditions of the Boksas make them out to be Powár Rajputs descended from Oodya Jeet, (or his relative Jug Deo) and his followers, who in the 12th century left his native place in Rajputána on account of family quarrels and came, either mediately or directly, to settle here.

In reply to the inquiries I made on these points, instead of frequently, or at all getting a connected account like the above, the only assertions that most of these Boksas agreed in, were two, viz., that they are of Rajput origin, although they confess that the Rajputs of the plains hold them impure on account of their less cleanly

habits, &c., and that they had come from the Dakkan, but even in this they were not unanimous. When they came to details, and many professed to know none, their statements were more varied than satisfactory. Thus, several of them agreed that they came from Dháranaggari, which, however, one man declared was close to Kangra Devi. One stated that they came from Delhi, and another that they had been driven from their original home in the Dakkan by the Marhattas; one *pudhán* stated that they came from Chittorgurh, "beyond Delhi" in the wars of the old Rajas, and the most intelligent *pudhán* of all, the only man among them that I met who could read, affirmed that they originally came from "Boondee Kolah" having been exiled thence "by the king." On this subject I found the three *purohits* quite as ignorant as the members of their flocks.

A still more curious statement, than any of these was made by an intelligent old Bengali Baboo, who has held a village in the Boksa district for many years. He solemnly affirmed that, before the commencement of British rule, the Boksas were Mussulmans in faith and ceremonials, and that, *in his time*, they had Hosseini Brahmins as *purohits*, and used verses of the Koran in their *puja*. This is a very suspicious story, at the same time it is difficult to see what motive the man could have had in narrating it.

It is not easy to reconcile the clear statements made to Elliot, especially regarding the origin of the tribe, with the above discordant and fragmentary information which alone is current among the western Boksas, and the explanation of the difficulty may be the following. If the story about Oodya Jeet is the true one, it would be more likely to be retained by the numerous and concentrated Boksas to the east of the Ramganga, than by the few and scattered members of the tribe to the west. Or, if that tradition is, as there seems reason to suspect, a mere concretion, resulting possibly from the original conversion of the tribe by Rajputs, and their centuries of contact with Hindoo castes and traditions, it may, in a similar way, have more readily assumed a definite form, where the tribe was most numerous and united.

Still less than my inclination to theorize definitely, are my qualifications to dogmatize on such a subject, but the suspicion has grown on me, since commencing inquiries regarding these people, that their origin may be very different from what has ordinarily

been supposed. It seems exceedingly unlikely that, had they been a tribe of Rajput extraction whom mere accident had driven to take refuge in this inhospitable tract six or seven hundred years ago, they would have, for such a length of time, remained so isolated as they undoubtedly have been, from other sections of Rajputs. But this is a minor difficulty, compared with the necessity to account for the very decided Turanian characteristics of feature which have been mentioned in detail, and which appear to be quite incompatible with a descent from any Indo-European race.

It may be objected that the language of the Boksas, barring slight dialectic differences, is identical with that of the ordinary inhabitants of this part of this country. But, not to lay too much stress on the circumstance that, in a case of this kind, positive is much more valuable than negative evidence, it is a recognized principle in ethnology, that the physical structure of a tribe, and the nature of their language, may change at very different rates, the possible alterations, in each, depending on very different conditions, and supposing that the Boksa originally sprang from a source different from that of the ordinary Hindustani, and that the physical circumstances in which he is placed are not such as, even in the course of centuries, greatly to alter the peculiarities of feature, &c., by which he was at first distinguished, it is difficult to conceive any position in which his language would be more likely to be rapidly and, at last, completely changed, than that in which he is now placed. Scattered in scanty colonies, over a very narrow strip of country, the language of the inhabitants, on both sides of which (we assume), differs wholly from that in use by him,—when each successive political or social convulsion in the neighbouring tracts, and, for hundreds of years, we know that these were neither few nor slight, was seen to be followed by an influx of these outsiders, what more likely than that his language should, at last, become completely assimilated to that of the latter?

The fact of the Boksas holding the Hindoo faith, and performing its rites, seems to me to present no stumbling-block in the way of adopting the view that they are of non-Aryan derivation. A race so few in number, and occupying so circumscribed a position, surrounded by Hindoos, and brought into close and frequent contact with them, would be likely to adopt the dominant religion almost as readily as

the dominant tongue. It is evident that, if my supposition is correct, all the traditions which assign to the Boksas a Rajput origin are baseless, but precedent are not wanting of tribes, assuming traditions in accordance with the history of their new co-religionists. Indeed, such traditions sometimes arise even where the smaller tribe has not adopted the religion of those who surround it. This is the case of the Nilgiri Todas whose ancestors are now represented to have been the palanquin-bearers of Kunya-Swámi, a Hindoo deity, though the Todas, far from being Hindoos, seem to have no religious beliefs or ceremonies whatever.

To the question, whence the Boksas came, and, if they are of Turanian origin, to which of the great tribes of that race are they nearly allied, the information at my disposal does not enable me to offer any definite answer. It may be, that they sprang fro.n the same source as the Bheels, Gonds, Coles, and other so-called "hill tribes" of Peninsular India, relics of the original Tamulian inhabitants of the country, still subsisting in the out-of-the-way corners into which they were driven by the Aryan influx. But it appears to be indicated by the fact of a series of analogous tribes occupying segments of the Sub-Himalayan forest-belt from Assam to the Jumna, and seems on the whole more probable, that the Boksas are the furthest authors of the stock whence sprung the aborigines of the northern part of the Malayan peninsula. In any case, if they are really non-Aryan, the complete substitution of Hindustani for their original language, and the thorough assimilation of their faith and customs to those of the surrounding race may form insuperable obstacles to their true relationships ever being found out. Here, however, I shall leave this subject to be discussed by those who are better qualified to handle it, in order to revert to less theoretical matters.

The Boksas conform to the Hindoo religion in an ignorant, unmeaning way, and the usual rites of that faith are performed on the occasion of births, marriages, and deaths. Marriage, as among the Hindoos, takes place at 8 to 10 years, and at this ceremony the *purohit* receives a fee of about four annas. After a birth, he gets from four annas to one rupee four annas. The bodies of the dead are burned at the Ramgunga, or other neighbouring large stream, and the *phúl* (ashes) are carried to Hurdwár, there to be consigned to Gunga ji, by a Brahmin

who gets a rupee or two for his trouble. Besides his special fees, each *purohit* receives a general contribution from every village in his beat, apparently amounting to about 5 maunds of grain each crop, which is allocated among families according to their means.

In small matters also the Boksas adhere to Hindoo customs. Thus, they do not wear their shoes (when they have any to wear) during cooking, and they kill animals to be used as food, by *jhaṭka* a blow or cut on the back of the neck, and not by the throat-cutting *halál-karna* of the Mussulmans.

A good many of the tribe are said to profess special devotion to particular deities, the only ones named to me being the spouse of Siva; under her designations Bhowani and Devi, with Baba Kalu and Surwar Sakhi. Of the personality of the last, I could learn nothing. Kalu Saiyid is a local saint, who, curious enough, they state to have been a Mussulman, as indeed the appellation Saiyid, if it be not a corruption, would indicate. Some traditions about his life and death are current, and before his shrine, at the entrance to the main pass through the Siwaliks into the Patli Doon, Hindoos of all sects make offerings, and his name "*Kalu Saiyid ki jai*" is invoked in the neighbourhood of the tomb on entering upon an undertaking, or when engaged in severe exertion such as heaving up a load, &c.

The Boksas only marry among their own tribe, but there does not appear to be any restriction within its limits. In this tract they will have nothing to say to intermarriage with the Tharoos (who, they declare, "eat frogs and lizards"), and there is some authority for believing that Elliot must have been misinformed, when told that some of the eastern Boksas, "in Kilpoory and Subna, occasionally intermarry with the Tharoos." The wife always follows the *paṭh* of her husband, and the children that of their father, in regard to a difference to be presently mentioned.

Their *purohits* are Gour Brahmins who hold the office hereditarily. They do not live among their flock, but outside the forest tract, one residing at Afzulghur, towards the eastern end, and two in Nujeebabad towards the western end of the *hathi*. One of those of Nujeebabad has the six most westerly villages in his charge, the other has the three in the centre, and the Afzulghur man has the four easternmost with the Patli Doon villages. I conversed with all

of these *purohits*, and found two of them apparently most ignorant and stupid, while the third was fairly intelligent, sensible and communicative.

A considerable proportion of the tribe follow *Nának Mathá*, *i. e.* have adopted the Guru of the Sikhs as theirs, indeed they are called Sikh by their brethren, and not *Nának sháhís* as followers of Nának are in Hindustan generally. The ordinary Boksa does not "take Nának's name" at all. In some of the villages, including Bugnalli which is by far the largest of all, the proportion of Sikhs to the others is very nearly or quite equal, but in some especially of the western villages, there are few or no Sikhs.

Among so rude a people as the Boksas, it would be vain to expect to find any elaborate set of religious tenets either held or understood by such a sect as these Sikhs, and accordingly their one distinctive mark is avoidance of spirituous liquor, opium and *charras*, which the Boksas in general use freely. The Sikhs will not even smell spirits voluntarily, nor will they use the hookah or eat in the house of one who has smoked on the same day. It is said that the *purohits* also adhere to the latter rule. Tobacco is lawful to the followers of Nának, and they, and the rest of the tribe intermarry without restriction, the wife and children as above mentioned invariably following the man's sect.

The Boksas bear an excellent moral character. I have no definite information as to their intimate domestic and social relations, but for three years at least, not one of the tribe had been a party in either a civil or criminal suit in the district courts. Any disputes that occur are referred to the village elders, and in extraordinary cases, it would appear that the *pudhán* of one of the more important villages (Bagnulli or Chuttroowali) is called to adjudicate, but such quarrels of any moment are extremely rare.

Their indolence and ignorance are fully as remarkable as their inoffensiveness. They have a strong objection to all labour which is not absolutely essential to provide means for subsistence; for example, near some villages immense quantities of manure, of which they well know the value, were lying unused, the trouble of taking it to their fields being too much for them; and they assigned as the reason for not collecting Kíno (*Mrakkigond*) in the forest that it would be *barri mehnat*, although it is really very light work.

They seem to have no spirit of inquisitiveness whatever, even in regard to points in which one would naturally suppose they might be interested. Thus it was frequently found, that they did not know who was the *purohit* of villages within half-a-dozen miles of their own: and several said that there were *no* Boksas beyond Nawabpoora, which is the most easterly village of *this* section of the tribe. As a specimen of their combined ignorance and credulity, I may mention, that a *pudhán* of one of the largest villages having brought up his sick child, for some time declined to answer any questions, believing that by merely feeling its pulse the details of the disease would be discovered, and that any information from him would be superfluous.

They have among them no arts or manufactures whatever, all clothes, leather, &c., being imported; nor do they, so far as could be learned, use a single medicinal substance. I only met one Boksa who could read, and heard of one other.

They are much more frank in manner than the villager of the plains of the North West Provinces, speaking their mind pretty freely, and they appear to have some sense of humour, which if the latter possesses, it never comes out in his intercourse with Europeans. One of the Boksas when asked what remuneration he got for being *pudhán*, answered with a grin "Nothing but *dikkat;*" the question, "What will you get, for having guided me, if you do not wait till my servants come up?" elicited "Plenty of *kántá* on my way back;" an old fellow on seeing me examining under the ribs of some of the others for spleen, complacently patting his lank abdomen said with a droll expression such as is often seen to accompany some stroke of "Scotch wut," "Do you think I've got spleen?" And I had a hearty laugh, one intensely cold morning, when on my suddenly stopping to ask the old guide who, with chattering teeth, was panting up an acclivity after me, some question about their traditions, he replied "I may remember by and bye, but its so *bara jáara* just now, I can recollect nothing."

Their only amusement seems to be the pursuit of game, terrestrial and aquatic, and they complained bitterly that the recent carrying out of the Disarming Act had deprived them of a chief means of livelihood. They are excessively greedy after animal food, and

Mr. Batten informs me Boksas have told him, that without wild pigs a Boksa would die. This statement has probably something to do with their fondness for sporting, but, independent of this, wild pig is said to be almost a passion with them.

The Boksas are undoubtedly restless in their habits, and there are more migrations from village to village than would appear to be absolutely necessary. Still, this propensity doubtless shows more strongly when contrasted with the generally extreme adhesiveness of the Hindustani agriculturist to his native village. Here, among the western Boksas, there is nothing like the "Never stay in a place more than two years" which Jones and others state to be the case with their eastern confreres. On the contrary, most of the former appear never to shift their village at all, and the most extensive changes going on of late years among them, seem to arise from the Government orders to clear the Patli Doon.

With the minor development of the nomadic instinct, shown by their restlessness, they evince unconquerable adhesiveness to their *natale solum* among the swamps and jungles. I could not hear of a single instance of a Boksa having emigrated from the forest belt, and they mentioned the existence of a tradition that no Boksa had ever gone abroad for service.

Although they are so fond of flesh, they keep no goats or sheep, and in only one instance did I find that a few fowls were kept. Agriculture may be said to be almost their sole employment, but one or two others, which are followed by a few of them at times, may be here noted.

A very small number of them ever engage in cutting bamboos or timber for export, and the collection of drugs and gums, which are largely produced and gathered in the forest, affords employment to almost none of the tribe. In some parts, however, they collect a few of these (viz. gum of *jingan*, *Odina wodier*, and *sohanjan*, *Hyperanthera pterygosperma*, *kamela* powder from the *Rottlera tinctoria*, *aorila*, fruit of *Emblica officinalis*, and *harra* immature fruit of *Terminalia chebula)* for sale to the *bunyas*, who come hither to buy such things. I have already here mentioned, that the collection of the *kino* of the *dhak* they object to as being too laborious, and probably we must attribute to sheer laziness the fact, that they do so

little in availing themselves of the natural products, which are literally scattered around them.

But the most important and interesting of the extra-agricultural avocations the Boksas ever engage in, is gold-washing, and it deserves a somewhat more extended notice. Within the last 25 or 30 years, the first part of the course of the Ganges, outside the Himalaya, furnished gold from its sands, but at present the Sona *naddi* in the Patli Doon, and the Ramgunga, below the junction of the former, are the only streams in this neighbourhood, whose sands are regularly or frequently washed. Little is done on the Ramgunga outside the Siwaliks, but there appeared every indication that the gold-washing was a regular employment of the Boksas on the Sona *naddi*, and there is reason to believe, that the proceeds derived from that minor Eldorado had a good deal to do with the manifest reluctance of these people to leave the Patli Doon, on the occasion of its being shut up for the preservation of the timber. In the aggregate, however, the amount annually collected does not seem to have been very large, for some years ago, the sum paid to Government by the contractor of the Doon as gold-dues was only 25 rupees yearly.

The Boksas say that there is nothing in the appearance, of the gold-bearing sand to let them know if it will be productive or not, and only "prospecting" by a trial will shew this. The sand itself is dug from the bed of the stream at many places extending over several miles, and the superficial layer generally contains much less gold than some of those a few inches below. In the sand, there seems to be a good deal of ferruginous matter, and there are iron-markings along many parts of the borders of the little stream, which here runs down an intra-Siwălik valley similar to, but very much smaller than the Dehra Doon. The soil, in and near the bed of the stream, is mostly gravel, and soft gray sandstone, similar to that of the Siwaliks, frequently crops out.

Three or four people, often members of one family, work in a gang, each having a separate part of the process assigned to him. A shovelful of the sand is first put upon a little close-set bamboo screen or sieve, placed over the upper hinder part of a flat *toon*-wood cradle *(sand)*, the lower end of which is open, and which has handles by which its

upper end can be tilted. Water is then poured on the sand from the mouth and lateral hole of a handled *túmrí* (pumpkin), the operator stirring the sand with his left hand while he sits alongside the cradle, which is raised a foot or two from the ground.

The sand having been washed through, the gravel left on the screen is tossed off, but the screen itself is left on, so as to soften and equalize the fall of the water from the pumpkin passing through it on to the sand, which the left hand keeps stirring about, and raking backwards toward the upper end of the cradle. After all the lightest of the sand has thus been washed out, small quantities of the remainder are placed on a round, slightly hollowed plate of *toon (pharú)* which is dexterously twirled and made to oscillate on the fingers of the left hand, while the washing is very gently continued. When as little as possible, and that consisting mostly of dark particles apparently of hornblende,—except gold, is left, mercury is rubbed with it by hand, to take up the gold, and the mercury is afterwards dissipated from the amalgam by heat. This finishes the process, which agrees almost entirely with that followed on the Biás, as described by Col. Abbott (J. A. S. March, 1847), the chief difference being, the trough used by the Boksas is considerably smaller.

The mercury is supplied to the Boksas at two annas a *mansurí paisa* weight by the same *bunyas* who purchase the gold from them, sometimes giving them advances on the possible future production, at sixteen rupees a tola. Several of the tribe, who could have had no possible collusion, stated that a gang of three or four people will average two annas worth of gold a day, and one man, of fair intelligence, said that into his village of under one hundred people, old and young, from one to two hundred rupees a year might come from gold-washing.

The gold is here invariably in minute particles, and the Boksas cannot conceive of the metal as ever being found in large pieces or imbedded in solid rocks; and a theory I have heard of the manner of its production has the quality of being as simple as are the people who credit it. Thus, it is said that the *sál* leaves which are burned by the forest-fires, act on any iron or copper which the soil or sand contains, so as to turn it into gold!

The agricultural operations and implements of the Boksas are the same as elsewhere in the N. W. Provinces. The chief crops of the hot weather *(kharif)* are rice, of several varieties, and *mandei (Mandua, Eleusine coracana)*, and of the cold weather *(rabi)* wheat with some *barley*, but besides these, most of the cereals grown in the open plain are also cultivated to some extent. Maize *(makki)* is but rarely grown, as it is said to be very subject to be eaten by wild animals (elephants, pigs and jackals!) So great is the damage to the crops by these, that the inhabitants of one village said, that since most of their guns were taken away, they had been obliged to give up cultivating a number of their outlying fields in consequence of not being able to protect the crops.

The pulses are very seldom cultivated, as the leaves are stated to be peculiarly liable to the attacks of *gindar*, a kind of worm which injures the plants so much as to prevent their maturing their fruit. For this reason, almost all the pulse used is bought from the bunyas. Another insect, *sundi* a sort of weevil, commits great damages among their stored grain, especially, they say, during the blowing of the *purwa* (east wind).

Nor are the pumpkin tribe cultivated, the reason given for this being that they do not ripen their fruit. This, if really true, is a very curious circumstance, the Forest tract being so moist that one would have supposed this class of plants would grow well.

A good deal of *sarson (Brassica campestris*, mustard) and lahi *(B. eruca*, rocket) are grown, chiefly for their oil, that of the former being used as food, that of the latter for burning. The young plant of the *lahi* is also consumed as greens,—as in France and other parts of Continental Europe,—and this is the only green vegetable they raise, such a thing as a garden being unknown among them.

Their agriculture is probably very slovenly, if one may judge from the large piles of manure near some of the villages, which they will not take the trouble to remove to, and spread upon, their fields. A still stronger evidence of laziness in this respect is, that they do not, so far as could be learned, raise a single stalk of tobacco, (which all use), although large quantities are grown in each village every year by *Sanis*. The latter are men of the plains and almost all of them reside in the forest for a few months only of each year, specially

for the tobacco-crop. A very few of them remain all the year in the forest (I met with one), and take two crops off the ground. The *Sanis'* houses are almost invariably in a little cluster apart from the Boksa village. I could not clearly discover what terms as regards land-rent are made with the Boksas. The facilities for getting excellent manure render tobacco a very luxuriant and lucrative crop, but men of the plains say, its quality is not so good as that grown outside the forest. The Boksas give as the reason why *they* do not grow tobacco, that it is unlawful for them to break off the top of the plant (as is done to prevent its running to stalk and flower); but this appears absurd enough, and the cause assigned for their allowing the *Sanis* to cultivate their village-land on any terms, viz. that the Boksas *have too few men*, seems to me almost equally so. It is to be found that laziness is the chief cause of both circumstances.

I can only give details, as to the area of land cultivated in proportion to the number of inhabitants, in regard to one village, and that the most comfortable-looking of all those visited. It contained less than one hundred inhabitants of all ages, and the extent of land under cultivation, for one or other or both crops, was about fifty acres. The Government land-rent paid by the Boksas appears to be in general exceedingly light.

After what has been said of the agriculture of the Boksas, it will be apparent that their food is of the simplest. It consist of bread made of the flour of wheat, barley, or some of the millets, or of rice with a small proportion of *dal*, and more rarely some *lahi* or wild herbs cooked as greens with a little oil. They also, as above indicated, consume a large amount of the flesh of wild animals compared with the ordinary inhabitant of the plains. And, were they always able to procure such food as the above, they would be, to say the least, no worse off than millions of the inhabitants of India. But, besides that the disarming process has affected their supply of meat, it will be at once evident, that if the proportion of land to population throughout is similar to that in the village instanced above, even were it cultivated in the highest perfection, sufficient food could not be grown for the inhabitants. We accordingly find that, even in ordinary years, most of the Boksas live for months on a wild yam, called *githi*, which, fortunately for them, is found in abundance in

these forests. The plant of which this is the root is the *Dioscorea bulbifera*, L. (*D. versicolor* Wall; *Helmia*, Kunth) which is common in the Sub-Siwalik belt as well as in the Himalaya to some distance inward. It is of the same genus as the West Indian yam, and as the *ratálu* which is cultivated for its tubers in most parts of India. The tubers of various other wild Dioscoreas are eaten in different parts of this country, and Buchanan Hamilton mentions one, with a similar native name *gength*, as being largely consumed by the savage *Bhars (Tharoos ?)* of the Goruckpore jungles. The plant is a graceful climber having large handsome, heart-shaped leaves, and with little bulbs (whence the specific name) in the axils of the leaf stalks. The Boksas say the plant is always produced from these bulbs rather than from seed, and as the tubers examined had exactly the same kind of markings on them as the former, this is probably for the most part the case. The tubers themselves are found at varying distances, from a few inches to several feet, under the surface of the ground. The plant is luxuriant from the commencement of the rains in June, till about March, after which, as the stem dies away, there is no clue by which to find the tubers, so that, for at least three months of the year, they are seldom if at all dug. The Boksas declare that the *githi* will not keep for more than a few days, after which it dries up or gets rotten, but, from various circumstances, it seems not unlikely that this was merely given as an excuse for their having none stored up.

These tubers weigh from an ounce to (it is stated) five or six pounds, averaging perhaps a pound. For cooking, they are peeled and cut into *phanks* (slices), which are put into an earthen vessel with water and ashes, the latter being added in order to remove the excessive bitterness of the raw tuber. They are then cooked over a slow fire for from six to ten hours, generally in the night-time, and are afterwards washed before being eaten. An adult, it is said, will get through from two or four pounds at a sitting, using as a relish flesh *(kahya)* or pulse.

The Boksas themselves assert that they always prefer the cereals as food when they can get them, and that it is only necessity which drives them to eat the *githi*. They say the latter merely acts as *pet-boja* and has no strength *(kuwat)* in it, and in the more prosperous villages it is never consumed except in time of famine. In some of

the worst villages, again, they affirmed that during the two years of the late famine they had no vegetable food whatever, except the *githi*. Still, with the usual tendency of mankind to make the best of a bad bargain in such a case, they attribute various virtues to this kind of food. Thus, they state that it does not cause thirst or flatulence, and that their freedom from spleen is attributable partly to eating it. Their estimate of it, as tending but little to strengthen the body, is much nearer the truth, as like the other yams, it is mostly composed of starchy non-nitrogenous matter, and long-continued subsistence on any such diet will tend to debility of body. This must be kept in mind when we come to consider the general questions as to the health of these people.

The Boksas are fond of tobacco, which, when they have no hookah by them, they smoke in a twisted-up leaf *(patwíri)*; and they took kindly to Cavendish, which, however, they found very strong after the light unfermented tobacco they use.

All the men except those who follow Nának, indulge in spirit drinking. Some of them denied that their women drink, or said that they never do so until past the child-bearing age; and one man indignantly asked "What need have they for spirits, since they do not have to go out into the jungle, or sit for a whole night up in a *tánd* (= *machán*) among the musquitoes, crying, *hoo-hoo* (to frighten wild animals from the crops?)" But it seems certain that many of the women also drink. Boys begin to consume spirits at the age of ten or eleven, and the adults confess that they all drink whenever they can get liquor. Yet, it would appear, they very seldom carry it to intoxication or so far as to unfit them for work, but are generally contented with two or three glasses. The liquor, here as elsewhere in the district, is manufactured from *shira*, and as it is sold at one anna and two annas a seer, this does not imply a very large consumption of alcohol. In one village, the *abkár* informed me that his customers comprized about fifty adult males, and his sales per month were equal to 80 seers of two anna spirits, which indicates a not very considerable average consumption of the liquor such as it is.

The best of their *purohits* often lectures them on their drinking habits, declaring that when they get a few annas they invariably run off to the *bhatti* to invest them, but he confessed with some sadness

that his admonitions do no good, while the Boksas standing round half-laughing denied the charge of drinking more than is good for them. They affirm that the spirits help, with *githi* and flesh to save them from spleen and *badi.*

I now come to what is practically perhaps the most interesting question connected with the Boksas, viz., their general state of health and the diseases to which they are liable. And, in palliation of the meagreness of what I have been able to discover under this head, it must be remembered that, among savages like these, each little fact must be expiscated separately, and the information derived from one man checked by repeated cross-questioning of him and others.

It may be premised that inoculation is quite unknown among them, and all denied that they use any medicinal substance whatever. As one man put it "What medicine do we know except *Bhagwán kí nám?*"

The only diseases unconnected with malaria regarding which particular inquiries were made, were urinary calculus, leprosy, cholera and small-pox. Cases of the two first have occurred among the Boksas, but the aggregate number of the tribe is so small, that no generalization of value could be made as to the rareness or frequency of these diseases among them, as compared with the inhabitants of the district generally.

Only one epidemic of cholera was mentioned to me. This occurred in 1862, and carried off nineteen people out of one middle-sized village. One sporadic case appeared in another village apparently about the same time.

The people were able to furnish some particulars of epidemic small-pox in five different villages, four of them apparently in the same year. The details indicate very varying intensity, as in two of the epidemics, although a good many children had the disease, no deaths occurred, while in each of the other three, ten to twenty, mostly young persons, died.

Ordinary intermittent fever is not unknown amongst the Boksas, but it is by no means common, and a number of those examined had had no attack for many years. Deaths occasionally occur from a form of fever which seems from their description to be a typhus with bilious complication, and which proves fatal in five or six days, if at all.

In a proverbiably malarious district like that inhabited by these people, one might have been prepared to find the "Spleen-test," of some importance, and I was somewhat surprised to discover that in not one of the numerous adults examined, was the spleen notably enlarged. Indeed most of them had never heard of such a thing as *pilaí*, while those who had, generally attributed their freedom from it to—as usual the *githi* and alcohol they consume. The percentage of enlarged spleens among the inhabitants of a district, as a test of the intensity of malaria in it, was first proposed by Dr. Dempster, when on the "Canal Committee" in 1847, and, since that time, it has been held as a dogma by probably the bulk of the profession in India, that a large number of "ague cakes" shew increased malarious activity in a district, while a blank return as to enlarged spleens would indicate absence or weakness of the miasm. Indeed, a report is on record, by a member of our service, who, when acting on a committee appointed to select a sanatarium, having in the course of a few minutes examined some of the residents of the village, and found few or no enlarged spleens, immediately pronounced the site "free from fever influences." But the almost total absence of spleen affection among this tribe, who inhabit from year to year, and all the year long, a tract where all the elements generally considered necessary, for the development of malaria are in full perfection for several months each season, and where it is but too certain that the miasm itself exists in the greatest activity at that time,—would induce us to believe, that there is still some datum to be discovered ere the "spleen-test" theory can be formalized.

Nor are we by any means at the bottom of the question of acclimatization so-called, in regard to a case apparently so simple as that of the Boksa living in comparative health throughout the year, in a tract twenty-four hours of many parts of which, at certain seasons, would be deadly to the newcomer. The Boksas' comparative immunity from malarious fevers has frequently been attributed especially to two causes; 1st, their not going out of doors after sunset in the fever-season, and 2nd, their houses being raised on poles at that time. Unfortunately, among our Boksas, neither of these habits has any existence,—houses on poles are unknown, and although in the rains, the Boksas naturally are not inclined to go out after dark

if it is avoidable, yet they make no special difference on account of the risk of fever. Thus those whose turn it is to go out and spend a night up in the *tánd*, in order to drive away wild beasts from the crops, do so in the rains as at other times. Nor are the Boksas the only people who may become "acclimatized." I met at least one *Sáni* who had spent two complete years in a Boksa clearing and had no fever. Again, some others do not so easily undergo the "acclimatizing" process. I inspected one *gote* of herdsmen from near Almora, of whom a certain number had that season (as in other years) remained down to tend their herds throughout the rains, a very large proportion of them had had fever severely and at least one had very bad spleen. Very many of these *gotiyas* suffer severely in the forests during the unhealthy season.

If we cannot as yet explain fully the cause of this difference, I may at least state in what respects the habitations of the Boksas and of the *gotiyas* ordinarily differ from each other, more especially as the differences observed tend to confirm the truth of modern views as to sanitary improvements. The Boksa villages are generally situated at some distance from forest and jungle, in or near the centre of the wide open space comprising their fields; they consist of one very wide, roomy, clean street, unencumbered by out-houses, &c., the floors of the houses are raised a foot or more above the surface of the ground, and are kept beautifully clean; the cattle are almost never lodged under the same roof with the human residents, except when there is great fear of tigers, and then they are in a separate chamber divided off by a well-lipped wattle and dab partition; nor is their dung allowed to accumulate close to, far less in the house.

In almost all these respects, a *gote* shews a very marked difference from a Boksa village. The former consists of immense quadrangular sheds, which are not necessarily or often pitched in an open space, but, as more frequently happens, are surrounded close up to their doors by forest and brushwood. In these sheds the herdsmen and their herds live in common, the former occupying the inner, the latter the outer end of a shed. The floors of these are not raised above the level of the ground outside, and the dung of the animals is not, so far as I could learn, removed for many weeks or months at a time, or at most only to just outside the doors, so that the whole place is one vast

dunghill and affords by no means a pleasant promenade even in the cold weather. With our modern views as to the effect that filth and close, foul air have on health, we need hardly wonder that the *Gotiya* is more subject to sickness than the Boksa, or that the latter attributes the greater liability of his neighbour to fever to the state of uncleanliness in which he lives.

In the course of my inquiries among the Boksas, it became evident that there is a very strong scorbutic tendency amongst them, of which the state of the gums affords a fair indication. In this pre-eminently statistical age, it would have been more satisfactory had I been able to give a good many figures bearing upon this point, but my attention became directed to it so late that I can speak positively as to the state of the gums in ten men only. These were taken promiscuously, and the gums of *nine* were more or less livid, spongy and hæmorrhagic, the one exception, with sound gums, being a robust young lad. In order to have some ground for comparison, the gums of several scores of prisoners in the Bijnour jail were subsequently examined on admission and at the time of discharge, and, with the exception of 2 (or 3) old thin-blooded men, and one lad who had been subject to considerable privation ere admission, the gums of all were healthy. These were sound even in the case of several who had been for some months on the *havalát* diet, which consists of only 16 oz., of flour with 4 oz., of pulse or 10 oz. of fresh vegetables.

The hæmorrhagic tendency of the Boksas appears to be shewn also by the great frequency and fatality of dysenteric affections among them. Of seven deaths, the causes of which were at various times, and without special design, detailed to me, five were from simple dysentery or diarrhœa, and two from dysenteric complications of fever and small-pox (respectively).

It may be a question whether the malaria, though it does not cause fever among the Boksas to anything like the extent which might be expected, has not something to do with the lowering of the system indicated by these purpuric or scorbutic symptoms, but I do not think we have any cause for it beyond the wretched food on which many of these people live. It has been seen, that the area of land tilled in a village is generally much less than would provide a sufficient quantity of cereals for the inhabitants under any system of culti-

vation however energetic, and that consequently, except in one or two favoured villages in good seasons, the mass of these people mostly subsist for a great part of the year on the wild yam, which does not contain all the elements for properly replenishing the blood,—that their supply of pulse which might supplement this want is not large, and that they grow almost no vegetables. Doubtless the flesh they eat, when it can be got, tends to lessen the detrimental consequences of their monotonous and miserable diet, but with the Disarming Act even partially enforced, they do not get the full benefit of that palliative. They are, at the best, but spare small men, and become prematurely old and feeble. Men of forty I have noted as "thin, grey, and breathless," and they themselves attribute their ailments to scanty food.

It would appear that the state of system induced among the Boksas, by the circumstances of their diet, is similar to that arising among some classes of the Irish from continued subsistence upon the potato alone, as detailed in a paper read to the Dublin Royal Society by a medical member in the course of last year. It is also analogous to that condition which is noted by Dr. Mouat as leading to the fearful mortality among the Sontals, and members of other wild tribes in the jails of Bengal, and which has also at times been observed among prisoners in Great Britain, in consequence of ill-advised changes in the dietary. Within the last few months, the existence of a similar state of constitution caused by poor diet has been suggested, by an experienced medical officer, as predisposing to the fatality of epidemic fever among the prisoners in the Punjab jails. This state of system, as existing among the Boksas, is perhaps more nearly allied to scurvy than to any other disorder, and although they or other people, in a condition of freedom, in whom it exists, probably seldom die *immediately* from it, yet it renders them infinitely more liable to succumb to attacks of epidemic or other disorders.

It is likely that the debility so evident in the adults likewise exists in the children of this tribe. Besides the numbers of young persons alluded to above, as carried off by epidemics; of 14 instances in which the age at which death occurred was incidentally mentioned, eight occurred before puberty, only six afterwards; and in almost all the families whose circumstances happened to be detailed, the minority

only were then alive, and in only one of these, had so many as three persons reached manhood.

The statements given above, however, though significant enough as indications, may not be very definite or on a sufficiently large scale to convince; the following facts do not labour under the latter defect. Seven Boksa villagas have become extinct, and no new Boksa settlements have been formed within our limits, in the memory of living men, and as the Boksa does not emigrate from the forest, the question arises "What has become of their former inhabitants?" There is *no* trace of any of them having migrated to the villages of the eastern Boksas beyond the Ramgunga, and only a very few from the westernmost extinct village Lullutpore, appear to have crossed the Ganges into the Doon Boksa settlements, so that naturally one might expect the existing villages to have increased. But the fact is that of seven of the villages, where special inquiries were made as to increase or decrease of the population of late years, the largest of all (Bugnulli) had slightly increased, two others had remained stationary, while the remaining four had decreased from 50 to 90 per cent., and either figure will leave a margin, even for the irrepressible inexactness of the oriental.

While trying not to exaggerate the importance of these facts and indications, I cannot resist the impression that these western Boksas, the far outliers, as I presume, of one of the aboriginal races, are surely and not slowly, dying out. Several causes seem to contribute to this process. First among these may be put the unhealthy climate of the forest-tract, although it is impossible to say how, or to what extent, it acts in impairing the health of the race, or to separate its effects from those of the other agents in operation. Second, and most palpable, is the miserable diet on which most of the tribe habitually subsist; and third, the effect of epidemics is most fatal among a people whose blood is impoverished, and their strength impaired by the preceding causes. It has been seen that epidemics of small-pox, in particular, are frequent, and often fatal among the younger Boksas, and, had I remained longer in the district, I meant to have taken steps for sending vaccinators amongst them, so that the severity of this scourge might be lessened in its future visitations. It is possible, however, that ere this time the Boksas have come within the range of the general vaccine operations for Rohilkhund.

It might be supposed that Boksas are frequently killed by tigers and other wild animals, but I only heard of one man who had perished thus, having been killed by an elephant. I was subsequently informed, on doubtful authority, of three of them having been killed by one tiger, in 1863. In all likelihood, the frequency of wild beasts near their villages at certain seasons, renders these people peculiarly wary. At the same time they have the reputation of being very daring with tigers. I met one man who had been seized and mangled by a tiger a good many years before. The brute having been driven off by the other Boksas, who had no fire-arms, was shot by the wounded man as soon as he let him go, although he was laid up with his wounds for many weeks afterwards.

In bringing to a close these obervations on the western Boksas, attention may be directed to three special points which have come out more or less strongly in the course of them.

The first of these is a fact, which may possibly be of some practical moment, viz., the certainty that, among the inhabitants of a strikingly malarious tract, the proportion of enlarged spleens is not necessarily great, as the prevailing opinion would have us to believe.

The second point is also of some importance, not only as bearing on the inquiry, as to how, and to what extent the Boksas resist the influence of the funereal tract in which they live, but as related to the great sanitary questions which are agitated in the present day: it relates also to the nature of some of the circumstances in the sites and construction &c., of the Boksa villages, which apparently have some effect in warding off the deleterious effects of the climate, during and after the rains.

The third point is a mere hypothesis, and consists in the suggestion that so far from the Boksas being Rajputs, who migrated hither many generations since from Rajputana, as the traditions of the eastern Boksas say, they are probably either the relics of one of those waves of aborigines which the advancing tide of Aryan immigration drove from the Gangetic plain into the wilder recesses of the country, or, as is more likely, they constitute one of the extreme branchlets of that stem of the Turanian tree, which, rooted beyond the Kuenlun, has, at various times, sent its boughs far and wide towards the south. The materials available to me, under this head, are so scanty that the case

has necessarily been left "not proven." Some other enquirer may be able to throw fresh light on this subject.

But, even should these observations answer no very definite practical purpose, still, if my belief that the western Boksas are gradually vanishing be correct, it may be of some interest to have on record their peculiarities while they are still numerous and united enough to deserve and repay attention, and I shall not consider my labour lost, if, in the opinion of those whose views are worth having on such a subject, this end has here been at all adequately fulfilled.

*Religion, Mythology, and Astronomy among the Karens.**—*By the Reverend* F. Mason, *D. D., Missionary to the Karen people.*

[Received 7th September, 1864.]

Religion.

The Karens pray more, and make more offerings than the Burmese; but their only object in these observances is to obtain benefits in the present existence, principally health and prolonged life, so they cannot be regarded as religious; while the Burmese make them to procure benefits in a future state, and are therefore a religious people, though by no means so moral as the Karens.

The Karens believe in the existence of one eternal God, the Creator of heaven and earth, and have traditions of God, and the creation that must have been derived from the Old Testament Scripture. The following affords a specimen:—

"Anciently, God commanded, but Satan appeared bringing destruction.

Formerly, God commanded, but Satan appeared deceiving unto death.

The woman E-u and the man Tha-nai pleased not the eye of the dragon,

The persons of E-u and Tha-nai pleased not the mind of the dragon,

* The following pages have been prepared in reply to "Queries respecting the human race addressed to travellers, by a Committee of the British Association for the advancement of science."

The dragon looked on them,—the dragon beguiled the woman and Tha-nai.

How is this said to have happened?

The great dragon succeeded in deceiving—deceiving unto death.

How do they say it was done?

A yellow fruit took the great dragon, and gave to the children of God;

A white fruit took the great dragon, and gave to the daughter and son of God.

They transgressed the commands of God, and God turned his face from them.

They transgressed the commands of God, and God turned away from them.

They kept not all the words of God—were deceived, deceived unto sickness;

They kept not all the law of God—were deceived, deceived unto death."

Other traditions may be found in the appendix to a little book published by the London Religious Tract Society called "The Karen Apostle."

The names *Tha-nai*, and *E-u* in the above verses are sufficiently near the Biblical names of Adam and Eve to show a common origin; while they are so diverse from any mode of rendering those names adopted by either Roman Catholic or Protestant Missionaries as to prove they have not been derived from modern names.

The scriptural traditions have been found principally among the Sgaus, and as we leave the Sgau tribes, we meet with others that seem to me to have had a Hindu origin. Such are some of the traditions among the Red Karens. They say: "Anciently God created the heavens and the earth, and he formed two persons. One was called 'the female Tha-lu,' and the other 'the male Tha-lu.' God placed these two persons to superintend the whole world. And God created trees, and animals of every kind, and he wrote their names in a golden book, and gave it to the two persons whom he created, and according to the names found in the book, they called every thing. God created all things by his word and his power. He created every thing with a body, with seed, and with fruit." Thus far the tradition preserves a Biblical character, but they go on to say: "God did not

create all things at once. When God created the earth at first it was not as large as a cotton spindle. There was not as much in it as there is in a butterfly. And God commanded that the male Tha-lu should rule over the sky, and the female Tha-lu should rule over the earth, and all the animals on it. And that which made the earth increase was the earth-worm, and that which made it firm was iron, and that which sewed the earth together was silk. And before the iron and the silk had united the ground, the whole earth was covered with water. God was not pleased with the look of it, and he separated it by pressing the earth together with iron and silk, when the water flowed out and became rivers and seas, and the dry land appeared with its mountains and hills. And the three things that helped the earth, were the earth-worm, iron and silk. There was a spider in the sky, and he was able to pass to and fro between heaven and earth.

"The first mountain that was created was Lwie-nya; and the first rivers formed were La-ko-meu,
Lie-la-sho, and
Mai-e.

"And the river Lie-la-sho had its sources among the mountains of Rako-sho.

"And God created a precious stone, and it became a great tree, and the first tree was Than-du, and the first grass was the *Chrysopogon acicularis*. And the first bird he formed was the Night-jar, and the first fish was Tai-pai-men-bu, and the first snake was Die-lo-to.

"God created two suns, one was the husband and the other the wife, and they were shut within a palace with stone gates, and gave no light. God therefore gave the Pangolin to eat a hole through the gates which it did, and broke out all its teeth, and then the suns came forth, but the heat was so great that neither man nor beast could endure it. Therefore man entreated God to destroy one of them. And God told man to make a bow, and to shoot an arrow into the face of one of the suns. So the man went up into the valley of mount Ra-ko-sho, and shot an arrow into the face of one of the suns, and it ceased to give light and became the moon, which God appointed to rule over the night."

Another version of these myths is given as follows: "The Red Karens say: Where, or how God came into existence, they know not;

but they know that there is a God who has power over all things; and that this God existed before the creation of the heavens and the earth. He was like the air, and lived in the sky, like the wind; and like the wind he went about everywhere. This he did through his inherent power.

"And God prepared himself to create the inhabitants of heaven, and the inhabitants of earth; but before he created heaven and earth, he created two persons. The one a male, called the 'male Tha-lu,' and the other a female, called 'the female Tha-lu.' The signification of Tha-lu is to float about like the wind. They do not fall to the ground like a man from a tree top, but remain in the air.

"God put into the hands of these two persons the work of superintending the heavens and the earth. He appointed 'the male Tha-lu' to take care of heaven, and 'the female Tha-lu' to take care of the earth. Then when these people saw any deficiency, they asked God for what they required, and he gave them seeds and the elements of things, in order that they might make the earth complete.

"Some say that he who created all things under the direction of God, was Ie-a-pai; but the greater part say they were created by 'the male Tha-lu,' and 'the female Tha-lu,' and that the person who shot the sun's wife in the face was called Thye-kha. These four persons are regarded by the Red Karens as working for God continually. They also speak of another super-human personage that they call Pai-ie-pai-bya."

All the Karen tribes have traditions of God having once dwelt among them, but as having forsaken them. The tradition is varied. Sometimes he is represented as dying and rising to life again; and sometimes simply as departing. We have in verse the following:

"Ywah, about to return, commanded, commanded;
Ywah, about to depart, commanded, commanded;
He commanded the sun to come and weep for him,
He commanded the moon to come and weep for him,
He commanded birds to come and weep for him,
He commanded squirrels to come and weep for him.
Worldly people set themselves up;
Worldly people came not."

A Sgau story says: "Anciently God dwelt with the Karens, and they said to him: 'Thou art very old.' He replied: 'I will kill

myself by a leap;' and he called all his children to come and receive his dying commands. They came, and after each had been charged, he leaped into the sea. The Karens ran away into the jungles, but the white foreigners could not run, and they said to the Karens: 'Elder brother, I will go to where father commanded me.' The Karen replied: 'I will not go.' But the white foreigner went to his home, and leaping into the sea, brought up the body of his father. His father said to him, 'I am not dead;' and he gave orders to his children to come and receive his commands again, as he was about to go away. But the Karens had run away afar off, so he said to the white foreigners: 'Do not stay here.' And he washed them over with sandal wood, and said: 'If you stay here, the Karens will persecute you.' So they followed their father, and he gave them another country.

"The Red Karens say that anciently, after the transgression, God called all the different races of men together to learn to read, and all went, and every one studied zealously except the Karen, who did not study in earnest like the White Foreigner, the Chinese, and the Burmese. He went to and fro, and played, and did not understand books like the others. After a while, God dismissed the people and all returned home, but the Karen was not skilled in books, like the other nations. Still God had given him a book, but when he would study it at home, his wife scolded him, and drove him off to work. He therefore forgot what he had learned, and did not take care of his book.

"One day, while he was absent, his book fell into the fire, and was burned, and being unable to write, the Karens have had no books from that time to the present. However, they observed the variegated marks left by the letters of their books in the ashes where it was burned, and they made diligent efforts to embroider those forms on their dresses. Hence it is that the Karens are able to embroider different forms on their dresses. Had they not looked, and imitated the letters of the book that was burned, the Karens would not be skilled in any thing."

The above is from a Bghai assistant that spent two years among the Red Karens.

TA-YWA.

The Sgau and Pwo name of God is Ywa, but the Bghais use a prefix and say Ta-ywa. To this name Ta-ywa, they attach long fabulous legends of which the following is one; and appears to be of Hindu origin.

The Elders relate concerning Ta-ywa and say: There was a woman who was pregnant, and when it was hot, she went and spread a garment out to dry in the sun, but so soon as it was spread out, it ceased to be hot, and clouds came up. Then she cursed the sun, and asked: "At first thou madest it hot, but now thou hast made it cloudy: Why is it so? The sun cursed her back in return, and said: "I wish thou mayst be pregnant three years, and when the child is born, may it be no larger than a jujube!"

After this, the woman remained pregnant three years, and at the end of that time, she was delivered of a son not larger than a jujube. The child eat, at first, as much rice at a meal, as can be put in the cover of a rice chutty; and after a little while, he eat a wash-bason full, and could wrestle with an ordinary man. After another short period, he eat as much rice as would cover a small table, and could wrestle with a strong man.

He asked his mother why he was so small, and she repeated the circumstances as related above. Then he said: "I will go and compel the sun to make me grow larger." Every morning and every evening, he worked hard to make himself a bow; and when he had finished it, he went up to the sky, to the place of drawing water of the sun and moon, and there he met the children of the sun and moon coming to draw water.

He bent his bow, and placed his arrow on the string, which was an Areca Nut tree as long as the height of a small mountain. Then he said to the children of the sun and moon, "Go tell your father to come here, and make me larger."

The children of the sun and moon were afraid, and said to their parents: "This man is very bold, and he said to us: 'Tell your father to come here and make me larger.' And he was about to shoot us with his bow."

The sun said: "If that be the case, let a cock go down and pick him to death." Ta-ywa drew his bow, laid on his gigantic Areca

tree arrow, and took aim at the cock, saying: "Tell your master to come down and make me great." The cock flew away screaming with fright, and told his master that Ta-ywa was very fierce.

In like manner, the sun sent a hog, and the hog was afraid. He sent a horse, and the horse was afraid. He sent an elephant, and the elephant was afraid. Every thing was afraid of him.

Then the sun said: "If it be thus, then make the waters rise, and he will be drowned." So he made the waters rise, but Ta-ywa made a boat, and remained quietly in it. When the waters fell, the sun said to his children: "Now that fellow is dead, go draw water." So they went to draw water.

Ta-ywa said to them again as before: "Go tell your father to make me great." The children were afraid, and returning to their parents said: "That fellow is not dead."

Then the sun said: "If it be so, we must make it burning hot." So he made it so hot that no one could endure it; but Ta-ywa created a banyan tree, and dwelt under its shadow.

After the heat had passed away, the sun said to his children: "Now that fellow is dead, go draw water." They were met again as before, and sent back with the former message; and they went and told their parents that they did not dare to go again to draw water. On hearing this, the sun made a bamboo tube, and went to Ta-ywa, who said to him; "Make me great." The sun took the bamboo tube, inserted it in him and blew him up larger, and larger, and asked: "Large enough?" Ta-ywa replied: "Not yet large enough." He blew again, asked the same question, and received the same reply two or three times, till Ta-ywa was satisfied, but when he rose up, his head hit against the heavens. The sun then flattened it down with his hand till it was low enough, and then departed.

When Ta-ywa returned home, the people said: "He is very great." And they envied him, and determined to kill him by stratagem. So they said to him: "Thy mother has no stones, on which to place her rice pot on the fire, let us go and bring her some stones." Then they went, and sought out the largest stone they could find, and all the village went to work to dig it up, and in order that it might roll over him and kill him; they said: "Go watch below, and carry it." So he went below on the side of the hill where they were digging, and

waited in the road to intercept it. When the stone came rolling down, he ran and took it up, and carrying it to the house said: "Where shall I put it?" They replied, "The house will break down." So he put it on the ground.

Then they devised again to kill him, and said: "Thy mother has got fever, and there is no large wood to make a great fire for her, go and bring some." So they sought out a large wood-oil tree, and went and cut it down, and told him he must receive it on his shoulder. He therefore caught it when it fell on his shoulder, and carrying it to the house asked: "Shall I put it in the house?" The people replied: "The house will break down." So he threw it on the ground.

Then the people said: "Ah, the rock rolling on this man did not kill him; the wood-oil tree falling on him did not kill him; but were a tiger to seize him, perhaps he might die." They therefore said: "Thy mother's fever continues, though we have offered fowls and hogs to the spirits, but were we to offer a tiger, she would recover." So the people made him go seek a tiger, in the hope that a tiger would seize him. He, however, had no fear, but went in search of a tiger's track; and after finding a very old one, he followed it up till he found the tiger, which he seized and carried alive to the house, when the people said: "We are very much afraid. Go turn it loose." So he took it back, and let it go free.

While his concubine was seeking vermin in his head, she was moved with compassion for him, and the tears dropped on his thigh. He said: "My faithful girl, what is it? It does not rain. Why is it that water drops on my thigh?" His concubine replied: "Ah, my dear boy, people are envious of thee and laying snares to kill thee." "Indeed!" he answered, "Is it really so? If people do not love me, then I will go away."

Every morning and evening, he worked on a bugle to give it a pleasant sound. When he had finished it, it blew out of itself, "Father and mother do not love me. Brethren two go abroad."

He said: "That is pleasant," and he prepared food for his journey. A hog of five spans round the body, five bundles of salt, five rolls of fish, and five baskets of rice. With this he started, and blew his horn as before, till he met with "Long-legs" planting, who had a silk-cotton tree stuck in his hair, whose shadow covered seven coun-

tries. While he made holes for the rice, his thirty concubines chopped in the seed. He said: "Ah, the hardest thing is planting. Who is this that comes blowing a bugle? Let us wrestle."

Ta-ywa said: "Ah, thy father and mother loved thee, so you can work and prosper; but my parents did not love me. They said I had grown exceedingly great, so I came away."

Though Long-legs planted rice with thirty concubines to sow the seed for him, he said: "Ah, it was so with me. Because my legs were long, they did not love me." He therefore prepared a hog of five hand-breadths, five baskets of rice, five bundles of salt, and five rolls of fish; and when his thirty concubines came weeping after them, he spit on them, and they turned to stone. Then the two went on their way.

Thus they travelled together, and the same scenes were enacted when they met in turn with Long-arms, Three-toothed, Broad-ears and Hollow-breast.

Having become six in company, they travelled together till they came to a fork in the Sitang river, made by an island; and there, they exhausted the water. Long-legs laid his legs across for a dam, Long-arms stuck his arms down perpendicularly for posts, and Broad-ears put his ear down on the interstices. Three-toothed bit up the fish, and Hollow-breast received them into his bosom.

When they came to divide the fish, Long-legs wished for all he could hold on his legs; Long-arms for all he could hold in his arms, Three-toothed for what he could take up with his teeth; Broad-ears for what he could hold on his ear; and they asked Hollow-breast: "How much do you want?" He replied: "I want all I can hold in my breast." His associates answered: "All the fish put together will not fill thy bosom. Why do you want so much?" And they quarrelled.

Then Ta-ywa, Long-legs, and Long-arms went in one direction; while Three-toothed, Broad-ears, and Hollow-breast went in another.

Ta-ywa and his associates met with Shie-oo, and they said: "We will cook rice." They went and asked Shie-oo to give them some fire, but he said: "I will not give to you. You must wrestle. If you throw me, I will carry the earth, but if you fall, you must bear up the earth."

This Shie-oo had a spur, like a cock, and when Ta-ywa wrestled with him, Long-legs came behind, and tripped up Shie-oo, but his spur entered the leg of Long-legs, and the blood flowed out like a river. When Shie-oo fell, Ta-ywa trod him down into the earth till he was immersed in it; and Long-arms thrust him down as far as his arms would reach; and then Long-legs trod him down as far as his legs would go; and he went down below the earth, and has to carry the earth to the present time. When the earth quakes, people say: "Shie-oo is raising himself."

Ta-ywa and his associates pursued their journey, and met with an empty house. After they had sat down, and drank water from a spout that brought down water from the brook above, they went up into the house, where they found a guitar. After Ta-ywa had tuned it, he played and sung:

> "The house is pleasant, is fair;
> The owner is where? Is where?"

The place where he sat was on the head of a very beautiful girl, who was hidden in the crevice of the floor, and she pinched him. He thought an insect had bitten him, and taking a cleaver he opened out the crevice of the bamboo floor, when he came on the head of the girl.

She said to them: "Ah, my dear boys, how is it that you are here? The great eagle has eaten my father and mother, my friends, and my brothers. My parents had compassion on me and hid me. How have you appeared? The great eagle will come and devour you."

They replied to her: "My dear girl, do not be afraid. Go beat out paddy and cook rice for us. So she went and beat out paddy, and cooked rice, and eat with them.

They asked the girl: "At what time does the great eagle come?" She answered: "When the sun passes the meridian, when it is half way down, and at sun-set." Then they said: "put up a split bamboo roof to the house, of seven layers; and below them a layer of iron." This was done, and then they made a tin bow, and an iron bow. The tin bow, they called the silver bow; and the iron bow, they called the old bamboo bow. Then they called out to the eagle singing:

> "Every thing has the Eagle devoured,
> Father, mother, and a wide land.
> Has eaten father and mother,
> But me in compassion they hid."

"Aha," the eagle exclaimed, "we said all were dead, and now we have found another quite unexpectedly." The oldest eagle came, and the sky became full of clouds. It became dark, it thundered, and the sun set. The eagle perched on the branch of a large wood-oil tree, but the branch broke, and it then flew up to the top of the tree and perched there, where it broke off a branch and picked its teeth with it, when the arm and leg bones of men fell out between its teeth.

Then it laughed, and said: "Aha! I said: can there be any thing more left? and here is the veriest trifle. Shall I dirty my teeth with it?"

Ta-ywa said: "Grandfather, you can devour me as a matter of course, but we try a bamboo, we try a tree. Let us try each other once."

The great eagle replied: "Why should we try? Be quiet, you cannot do any thing." Ta-ywa answered: "Nevertheless, things are tried; let us try."

The great eagle said: "Well then, how do you wish to try me?" He replied: "If you can strike through my roof then eat me; but if you cannot, you shall not eat me.

Then the eagle pulled a feather out of his wing, and with it struck through the seven layers of bamboo, but it did not go through the iron.

Ta-ywa immediately took the tin bow, and said to the eagle: "Where is thy heart?" He pointed to a spot on his side. Then Ta-ywa shot at the spot, but the arrow did not enter; so the eagle said: "Ah, you cannot overcome. Wait, let me eat you."

Ta-ywa said: "Grandfather, thou wilt eat me of course, but let me try a shot with this old bamboo bow." The eagle answered: "Eh, with the bow of glittering white if thou couldst not pierce me, how wilt thou pierce me with the rusty old bamboo one?"

Ta-ywa said: "I will try a shot. Where is thy heart?" He replied: "My heart is at this variegated spot." Then Ta-ywa shot, and the eagle fell dead.

When he had killed one bird, he repaired the roof and made it stronger than it was at first. Then he called and sung again, and a second eagle came, with which a similar course was pursued, and it was killed like the first, and so again with the third and last.

Then Ta-ywa ripped open the eagles, and took out the bones he found in them. The bones of men he placed in one pile, the bones of women in another, and the bones of the girl's father and mother in a third. Elephant bones, he placed by themselves; horses' bones, he placed by themselves; oxen's bones, he placed by themselves; buffaloes' bones, he placed by themselves; hogs' bones, he placed by themselves; dogs' bones, he placed by themselves; fowls' bones he placed by themselves. All kinds of animals, he placed their bones in separate piles.

This done, Ta-ywa made a strap, such as is used in holding a Karen basket borne on the back, on the head, and with it he struck the fowls' bones, when the fowls rose to life, and flew crowing away. In like manner, he struck the bones of each animal, and the animals came to life again. Last of all, he struck the bones of man, and the men came to life again. Then Ta-ywa said: "What has happened to you?" And they replied: "We have been asleep."

Ta-ywa planted two herbaceous plants, and left Long-legs in charge of the place, saying, If the plants wither, follow on quickly after me, and then departed.

He passed on and came to another empty house, where the hall was full of spiritous liquor. Here the same scenes were enacted as before, excepting that the girl was found in a spirit jar, and the destroyers were tigers. Before leaving, he planted the herbaceous plants, as before, and left Long-arms in charge.

Again he continued his travels, and met with another house without inhabitant, but he found rice spread out on the verandah to dry, and a number of pots of spiritous liquor. He sought a bamboo tube with which to suck it up, and having found one, he notched it at the bottom and drank. Here he found a handsome girl as before, and learned that three large Pythons had produced the desolation.

He dug a gallery under ground with seven bends, and put her at the end. Then he made two swords, and killed two of the serpents as before; but when he struck the third, the blade of the sword flew out of the handle, and Ta-ywa ran into the handle which the snake swallowed.

Immediately, the plants left behind withered, and Long-legs, and Long-arms followed on to the assistance of Ta-ywa. Long-legs went

kicking down the trees and bamboos as he went along, and the way being too narrow for Long-arms, he smashed down the trees and bamboos with the swing of his arms; but when they arrived, the Python had gone away.

Then they called it seven times, and the seventh time it came again. After the usual discussion, the two attack it, slashing at its head and tail, and finally killed it. When it was slain, they ripped it open, and found Ta-ywa in it dead. He was restored to life as others had been before; and then he separated from his friends and returned home.

He returned to his grandmother and younger brother, and told the latter to cook rice, while he went himself to the forks of the river, where he and his companions had at first dammed up the stream. When he returned, his brother was boiling fish, and the tail of one moved up and down by the bubbling of the boiling water as if alive. He said to his brother: "Why, it is alive! I went to look at the fish traps at the forks of the river, and have come back; and why art thou cooking a live fish?" Then he took his bow, and shot his brother dead.

He afterwards thought to himself: I ought not to have shot my brother. Then he set fire to a tuft of reed and ran round the edge of the horizon three times, and when he got back, the tuft had not done burning. He said: "I am very quick. I ought not to have killed my brother," and he repented.

After this, he was not happy, and he said: "I will kill myself." He made a bow, cocked the string, and laid on an arrow, and went to sleep beneath the arrow as he had set it, aimed at his head. A dove flying by, hit the cock, and the bow went off. He caught the arrow flying with his hand; and this was repeated ten times; but at last he forgot himself, and the arrow hit him.

For three years and three months, he grew very feeble, and at the end of this period, he called the monkey-tiger; and he sent him to call the Karens; and he called the Tupaia, and he sent him to call the Burmans. He loved the Karens more than the Burmans, therefore he gave the monkey-tiger a crayfish for food, that he might arrive quickly, because a crayfish is cooked in a short time, and he gave him a flint that he might get fire readily.

He had not much love for the Burmans, and that they might be slow in coming, he gave the Tupaia two bits of bamboo to rub together to obtain fire, and a bit of skin to eat, for it was difficult to cook, and the bamboos difficult to take fire.

When they departed, the monkey-tiger went up round all the crooks of the gigantic bean creeper, and slept one night by the way. When he cooked his crayfish, he said: "Why, it is blood red!" And it was long before he arrived.

But the Tupaia went rapidly. He was very hungry, so he roasted his skin a little, and eat it; and reached his destination in a short time. Hence the Burmans reached Ta-ywa first before he expired. They asked of him, and obtained horses, and elephants, and oxen, and buffaloes, and their dog asked for ears of paddy as large as the end of his bushy tail, and three crops a year.

The Karens did not arrive till after Ta-ywa was dead, and burned to ashes. His mats, and fanning baskets and carrying baskets were burned up and just their form and variegated patterns left in the ashes, which the Karens looked upon, and imitated.

Not satisfied, they followed on after the elephants, and tried to get on to their necks, but could not. Then he commenced driving bamboo steps into their legs, as when ascending trees; but this made them run away. Failing with the elephants, they tried to drag along the buffaloes with ropes tied to their legs, but could not make them go; and they tried the oxen with no better success; but the hog they succeeded in dragging along; so the Karens have hogs to this day.

The latter part of this story is versified, as follows:—

Go poison fish at Po, at Yau,
Go to angle at Po, at Yau.
Great frogs die, thou stayest to cook them,
Great fish die, thou stayest to cook them:
Thou remainest to cook them with thy brother,
To prepare them, thou remainest with thy brother.
Thou doest whatever cometh into thy mind.
Thou cockest the bow, layest on a red arrow,
Thou shootest dead thy younger brother:
Then thou repentest, sorrowfully.
Thou lightest the reed blossom, and boundest away
Three times thou runnest round the horizon,

Three times thou scamperest round the horizon.
Thou returnest, and the rice is not hot,
Thou returnest, and the fish is not hot.
Thou doest whatever cometh into thy mind :
Thou cockest the bow, layest on a red arrow.
One arrow flies, thou arresteth it in its flight,
Two arrows fly, thou arresteth them in their flight:
Thou forgettest that the arrow is flying,
The arrow hits thy heart.
Three years, three months, thou failest.
Thou sendest the Tupaia to Bamo
Thou sendest the monkey-tiger into the country :
But the monkey-tiger went slowly ;
When the crayfish was cooked, he said: Why, it is red!
The Tupaia went trotting along:
He reached Ta-ywa before he died.
Received extraordinary power to variegate cloth,
To weave beautiful as the Python's skin,
And have rice crops three times a year;
Became great and returned to Bamo,
But back went the poor to the hill of Kukoo.

Idolatry.

Though the Karens can tolerate all sorts of absurd legends about God, yet they cannot endure idolatry. They seem to have no more sympathy with it than Christian nations. One of the commands of the elders says: "O children and grandchildren! do not worship idols or priests. If you worship them, you obtain no advantage thereby, while you increase your sins exceedingly."

They regard the Buddhistic religion of their neighbours with considerable contempt. One of the couplets that they sing, referring to the sleepy looks of the images says :

"Gaudama is drowsy,
He cannot save us."

Far off on the mountains, I have often noticed one and another of the wild Karens wrapped up in a flashy yellow and tinselled robe, which he had abstracted from some pagoda; an act that the Burmese regard as the greatest sacrilege.

Some of the Karen stories seem to have been composed to turn the worship of pagodas into ridicule; as in the following where the worshippers are represented as taking the language of a rat for that of their god.

"There was a lazy dirty Karen young man called Sanken, and he one day caught a white rat and was about to kill and eat it; but the rat spoke up, and said: 'Do not kill me. I will get you a wife from among the king's daughters.' So he let the rat go, and it ran into a hole in the royal pagoda.

"When the king came and prayed to the pagoda, he said: 'May my power and glory increase. May my subjects become more numerous.' Then the white rat in the pagoda replied: 'If you will make Sanken your son-in-law, your power and glory will increase. Your subjects will become more numerous, your people will multiply.' The king supposed it was the image in the niche of the pagoda that spoke to him, and was astonished. He returned to the palace and told the Queen what had happened, but she would not believe it; so they both went to the pagoda, and the king prayed as before, and received the same answer in the hearing of the Queen who was then convinced; and they gave the lazy dirty Karen, one of their daughters in marriage."

Notes and Queries.

Zoology.

Reliable information has at last been supplied by Dr. Jerdon regarding the workers of one of the Indian species of Dorylus, an Hymenopterous genus, which, as F. Smith observes in his British Museum Catalogue, 'at present (1859) consists of males only.' The following extract from the Proceedings of the Entomological Society at their May meeting will perhaps induce others to carry on Dr. Jerdon's observations should opportunity offer.

Mr. F. Smith read the following letter from Mr. T. C. Jerdon:—

"*Lahore, March 16th*, 1865."

"I have at last got hold again, after a long absence, of the specimens of workers of Dorylus, and they are, as you suggested, evidently, I think, Typhlopone. It is, however, strange to say, quite a Termes in its *habits*, working under ground *entirely*, and never coming outside except when the males are coming forth winged, when they accompany them in swarms to the holes by which they make their exit. I first observed the workers at Mhow, in Central India, where they had undermined a house so completely that the foundation had to be dug up, and I there saw the winged males (*Dorylus*) issuing out of the same holes as the workers. I afterwards saw them twice again; the last time in a green-house of the Botanical Garden at Saharunpore, N. W. Provinces. They were issuing every morning and evening in great numbers from a hole in the flooring (lime), and several winged individuals were with them, and these entered houses at night: this was in February. I have met with Dorylus in every station where I have been, and it is certainly curious that the workers are so little known, as they must have been observed occasionally by hundreds of Europeans. I have a lot in spirits and enclose you three or four in this letter, enough, I dare say, to show if it is the same species mentioned in your 'Catalogue,' T. Curtisii, or not. Dr. Jameson laughed me to scorn when I talked of digging up the flooring of his pet greenhouse, but if I ever get an opportunity of another nest in a get-at-able situation I will try and get at the mystery of the female. Surely, however, some of the winged individuals must be females; if not, then

the only other conclusion is that the female always remains apterous, and is impregnated in the nest; or, if winged, that she is kept a forcible prisoner till her wings drop off. I would have written long ago, but was separated from the bottle containing the workers."

Mr. F. Smith thought there was now little doubt that Typhlopone was the worker of Dorylus, as had been suggested years ago by Shuckard. The female, however, was still unknown.

Prof. Westwood enquired whether Mr. Smith was acquainted with the insect which Gerstäcker represented to be the female of Dorylus; it was very different from Typhlopone. Mr. Smith replied that he had never seen the large female in question, but he believed its connexion with Dorylus to be purely conjectural.

The following discussion took place at the same meeting in regard to the flashing of fire-flies. Observation, we apprehend, will establish the irregularity of these flashings, as testified to by Mr. Bates and Mr. Saunders:—

The Rev. H. Clark read from 'The Reader' of the 1st of April, 1865, the following extract from a review of Cameron's recent work on 'Our Possessions in Malayan India:'—

" The following account of that very common tropical phenomenon, the light of the fire-flies, is altogether new to us, and not quite intelligible.—Does the author mean that the little insects actually keep time with each other so accurately, that thousands of them scattered over a shrub or tree all put out their lights at the same instant, and rekindle them with equal punctuality? If so, here is a new insect-wonder, before which the economy of bees and ants will sink into insignificance:—'The bushes literally swarm with fire-flies, which flash out their intermittent light almost contemporaneously; the effect being that for an instant the exact outline of all the bushes stands prominently forward, as if lit up with electric sparks, and next moment all is jetty dark—darker from the momentary illumination that preceded. These flashes succeed one another every three or four seconds for about ten minutes, when an interval of similar duration takes place, as if to allow the insects to regain their electric or phosphoric vigour.' We commend this as a subject of investigation for those naturalists who are so fortunate as to live among fire-flies."

Mr. Clark added that, though he was utterly unable to give any explanation of the phenomenon, he could so far corroborate Mr. Cameron as to say that he had himself observed this simultaneous flashing; he had a vivid recollection of a particular glen in the Organ Mountains, where he had on several occasions noticed the contemporaneous exhibition and extinction of their light by numerous individuals, as if they were acting in concert.

Mr. McLachlan suggested that this might be caused by currents of wind, which, by inducing a number of the insects simultaneously to change the direction of their flight, might occasion a momentary concealment of their light.

Mr. Bates had never in his experience received the impression of any simultaneous flashing; on the contrary, he thought there was the greatest possible irregularity in giving and extinguishing the light, and that no concert or connexion existed between different individuals; he regarded the contemporaneous flashing as an illusion, produced probably by the swarms of the insects flying amongst foliage, and being continually, but only momentarily, hidden behind the leaves. Mr. Bates further remarked that the light-emitting insects were Lampyridæ, not Elateridæ (Pyrophori), which rarely flew by night; the Lampyridæ had a weak vacillating flight, the number of species was very large, and he had himself found eighty or ninety species; several species would flit about together, and in the squares of Parà he had captured three distinct species; it would be curious if there were any concert or action in unison between individuals of different species.

Mr. Clark remarked that the lights of the Lampyridæ and Elateridæ were perfectly distinguishable; it was the former which gave the intermittent flashing light.

Mr. W. W. Saunders had frequently observed the fire-flies in Bengal, at Pondicherry and at Madras; they usually flew at a height of ten to fifteen or twenty feet, amongst the foliage; he had never noticed any flashing or regularity of intermission, and thought that each individual was perfectly irregular, and independent in the exhibition or extinction of its light.

M. Sallé (who was present as a visitor) had never observed any flashing or regular intermittency, or simultaneous emission or extinction of the light.

Prof. Westwood was unable to recall any analogous phenomenon; the simultaneity of the flight of *Empis* over standing water seemed to be the nearest in point.

The following is from our late Curator.

The Inuus assamensis.

In the Notes and Queries published in the last page of the Society's Journal for 1864, Capt. T. Hutton remarks that in my Catalogue of the species of mammalia in the Society's museum, I "make *Inuus assamensis* of Maclelland and *Inuus pelops* of Hodgson to be one and the same;" also, that I "never saw a specimen of *Pithex (Inuus) pelops* of Hodgson."

Referring to my Catalogue, I find that I placed *Pithex pelops*, Hodgson, as a synonyme of *I. assamensis* on the authority of the late Dr. Horsfield. *Vide* his Catalogue of the species of mammalia in the old India-house museum, now at Fyfe House.

Capt. Hutton may remember that he brought two living individuals of what he considered to be *I. pelops* to Calcutta, many years ago, from Mussoorie, which I saw repeatedly in his presence, though not to much advantage in the small cage in which they were confined. When his family proceeded to England, those monkeys were shipped; but what afterwards became of them, I am unaware.

Did Capt. Hutton ever see a specimen of *I. assamensis*, that he is enabled to pronounce so confidently on its specifical distinctness from *I. pelops?*

Not long ago, I examined the original specimen of *I. assamensis* procured by McClelland, which still remains unique; and I could not perceive that it differs in any respect from the common *I. rhesus*, excepting that the hind part of the body is not, as usual, strongly tinged with bright ferruginous or tawny, being uniformly coloured with the rest; and my present impression (liable to correction) is, that it is merely an individual variety of colour of the common animal of Lower Bengal.

Indian Rats and Mice.

With reference to my paper on these animals (J. A. S. XXXII, 327 *et seq.*), I hoped to have been able to reduce the number of nominal species considerably, on examination of the specimens in the British museum and the India museum; but the less known of them

are generally illustrated by such exceedingly bad and imperfect skins, that little can be satisfactorily made out from them.

The *Mus Hardwickii*, Gray, (noticed in p. 330,) rests on a single specimen in the British museum. It is certainly distinct from *Nesokia indica*, having a much shorter tail, measuring (vertebræ) but 2¼ inch; the fur dense, shortish, and of uniform length.

M. (?) *hydrophilus*, Hodgson, (p. 331,) has very soft fur, much finer than that of *N. indica.*

Nesokia Griffithii, Horsfield, (p. 332,) is founded on a young specimen of *N. indica.*

Mus setifer, Horsfield, (p. 334,) is founded on a bad and imperfect specimen of *M. bandicota*, (p. 333); but *M. setifer* apud Cantor, from Pinang, is very different, being identical with my *M. andamanensis* (p. 340.) The small specimen from Malacca in the Society's museum, doubtfully referred to *M. setifer* (in p. 355), is probably the young of *M. andamanensis.*

M. brunneus, Hodgson, (p. 335,) as illustrated by a good specimen in the India museum, is identical with *M. nemoralis*, nobis, (p. 340,) and Mr. Hodgson's name holds precedence; the species being nearly akin to *M. alexandrinus.*

M plurimammis, Hodgson, (p. 336,) in India museum, is a well marked species.

"*M. decumanoides*, Tem. (nec Hodgson,)" apud Horsfield, (p. 338,) is the common *M. rufescens*, (p. 340); and the *M. asiaticus*, Gray, (p. 341,) appears to me to be no other.

M. caudatior, Hodgson, and *M. cinnamomeus*, nobis, (p. 341,) are, I think, identical; but the Nipalese specimens are much less brightly coloured than those from Burma.

M. peguensis, nobis (p. 345.) I found a specimen of this strongly marked species, unnamed, from the Philippines, in the Derby museum of Liverpool.

M. bactrianus, *gerbillinus*, and *Theobaldi*, (p. 347,) are identical, as I suggested; and I have seen what appears to be the very same mouse from Syria and N. Africa. The specimen of *M. bactrianus*, originally described by me, is now in the British museum.

M. Darjeelingensis, Horsfield, (p. 348,) comes exceedingly close to *M. strophiatus*, H. (p. 349); and *M. terricolor*, nobis, to *M. minutoides* of S. Africa.

M. rama, Cantor; Syn. *M. musculus* apud Cantor, from Pinang. Akin to *M. musculus*, but more deeply coloured; the tail (vertebræ) $2\frac{3}{4}$ inch, with about 24 distinguishable vertebræ. A miniature of *M. concolor*, (344).

This is a small further contribution towards the elucidation of the difficult group of Indian *muridæ;* and little or no progress can be made in the investigation of the series until much better specimens are available for examination.

E. Blyth.

Mineralogy.

Syepoorite. In all works on Mineralogy, a simple sulphide of Cobalt, Co. S, is said to occur in Rajpootana and to be used by Indian jewellers for giving a red colour to gold. In a recent paper in the Journal by Col. J. C. Brooke, mention is made of a cobalt ore, a sulphuret, occurring with Copper ore at Khetree. Is this Syepoorite? There is not a specimen in any of the principal museums of Europe, or at least there was not a few years since, and should a careful analysis confirm the chemical composition assigned to the mineral, it is very desirable that specimens should be distributed.

W. T. Blanford.

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Religion, Mythology, and Astronomy among the Karens.— *By Rev.* F. MASON, *D. D.*

[Continued from page 188, Part II. No. 3.]

MYTHOLOGY.

FUTURE STATE.

Karen ideas of a future state are confused, indefinite, and contradictory. They seem to be a melee of different systems. That which appears to me indigenous Karen, corresponds to the notions of the American Indians. It represents the future world as a counterpart of this, located under the earth, where the inhabitants are employed precisely as they are here. When the sun sets on earth, it rises in the Karen Hades; and when it sets in Hades, it rises on this world. The following story is adduced by the Karens as proof of the accuracy of this cosmology.

"The elders say: There was a man who had a wife that he loved, and she loved him in return. His wife died, which distressed him beyond measure, and he said. 'If there be any one that will raise her up to life again, I will give him whatever he may ask.'

"A prophet or necromancer was found, who raised his wife from the grave, and restored her alive to her home in the night. She pursued her usual daily avocations throughout the night, but as soon as daylight appeared she died again, and remained dead all day, but revived at eve and went to work as people usually do in the morning. This course she pursued constantly. Hence it is manifest, that people in the next world work just as they do in this."

To these ideas are appended others that appear to have been originally derived from the Hindus. They say that Hades has a king, or judge, who stands at the door to admit or reject those who apply for admission into his kingdom. He decides the future of each. Those who have performed meritorious works are sent to the regions of happiness above; but those that have done wickedness, such as "striking father or mother," are delivered over to the king of hell who is in waiting, and who casts them down into hell; while those who have neither performed deeds of merit, nor are guilty of great crimes, are allotted a place in Hades. The Sgaus call this personage *Yu*, or *Tha-mie-Yu* and the Bghais *Tha-ma*. Both are probably derived from the Hindu *Ya-ma;* and his office and duties are as old as the earliest records we have of the Egyptian religion.

The Spirit World.

To a Karen, the world is more thickly peopled with spirits, than it is with men, and the occasions on which his faith requires him to make sacrifices and offerings to these unseen beings are interminable.

Every human being has his guardian spirit walking by his side, or wandering away in search of dreamy adventures; and if too long absent, he must be called back with offerings.

Then the spirits of the departed dead crowd around him, whom he has to appease by varied and unceasing offerings, to preserve his life and health.

Again there are all the conspicuous objects of the material world —the lofty mountain, the wide river; the shady tree and the inaccessible pricipice, every one of which, by the awe they inspire, demands reverence and respect from human beings, and punishes each breach of etiquette with sickness or death. These too must be propitiated.

Thus, though the Karens have no cumbrous written ritual of services and ceremonies, like the Mahommedans, the Brahmins and the Buddhists; they have yet an oral liturgy of observances, as burdensome as the services of the ancient Egyptians or the Mosaic ritual.

Guardian Spirits.

The word in Karen that designates the heart is also used for the mind and soul. The seat of all moral qualities is in the heart, and death is designated as the departure of the heart from the body.

Some German critics say, that "Psyche, in Homer, signifies only the breath and the life; never, as in the language of later times, the spirit or soul. Yet it goes to Hades and continues to live there." There is something like Psyche, as thus defined, in Karen Psychology; yet in many points more like the genius of the Latins; but differing as it does from both, it will be better in this paper to designate it by its native name; and explain it by its attributes. The Pwas call it Là, the Bghais Lai, the Sgaus Ka-là, and the Red Karens Yo.

This Là existed before man was born, comes into the world with him, remains with him until death, lives after death, and for aught that appears to the contrary, is immortal. Yet no moral qualites are predicated of it. It is neither good nor bad, but is merely that which gives life to mortality.

The Làs of a part of the dead remain on earth and become mischievous spirits; others go to Hades, where they are employed as on earth; others go to hell, where they suffer punishment; while others go to the Deva heavens, where they enjoy happiness.

Although in this state, the Là and the man himself, the Ego, are said to be distinct; yet in nearly all the representations of the future state, the man seems to be absorbed in the Là; and inconsistent as it is with previous representations, it then appears equivalent to the soul.

Sometimes it is spoken of as the man, before being united with the body. Thus a Bghai writes:

"The elders say: 'The God of the whole human race resides at the foot of the sun, at the foot of the moon; and people who are born are sent by God, and people who die are called back by God.'

"Men at the beginning are in the presence of God, and he sends them forth; but before sending them, he tries their courage. He takes a sword and lays it across an abyss as a bridge, with the edge uppermost, and orders them to walk over it. Those who dare to walk across it, are bold; and God sends them into the world men. Those who, after being urged two or three times, dare not go, God sends into the world women.

"When God sends them forth, he gives commands in relation to the times and the seasons of their return. It is related that a prophet, or necromancer, looking into the world of spirits, on one occasion saw seven men and two women coming into the world, and he heard them talking with each other. The first man said, 'God has ordered me to

go and return.' The second said: 'God has ordered me to return, after I am able to draw water.' The third said: 'God has ordered me to return, after I am able to weed.' The fourth said: 'God has ordered me to return, after I am able to make it easy for my father and mother.' The fifth said: "God has commanded me to return, after I am able to go to the Burman and Shan country.' The sixth said: 'God has commanded me to return, after I am able to cultivate paddy for my father and mother.' The seventh said: 'God has commanded me to return, after I have married.'

"The prophet said that after this he saw them all born on earth, all boys, and he noted that they all died one after another, as he heard them say in his vision.

"Of the two women, he said one carried two Kyee-zees, and the other a basket on her back, and a spinning wheel and distaff in her hand. The first one he heard say: 'God has commanded me to stay with my Kyee-zees, till I am white-headed.' The other one said: 'God has commanded me to spin thread and prepare cotton, till I am white-headed.' The prophet said he saw both born in this world females, and the one came in possession of two Kyee-zees, and the other spun thread and carded cotton, in accordance with his vision."

According to a Sgau authority, the Là promises God, before it comes, into the world, that it will die by one or other of seven things it says: "I will die in the mouth of a tiger. If I do not die in the mouth of a tiger, I will die of some kind of sickness. I I do not die of disease, I will die by drowning. If I am not drowned, I will die by the hand of man. If I am not killed by man, I will die by a fall. If I am not killed by a fall, I will die by a blow. If I am not struck dead, I will die of old age."

The Là sometimes appears after death, and cannot then be distinguished from the person himself. One story says:

"After a certain woman's husband had gone to the city, she died. On his return home, he met her Là in the road, and taking it for his wife in the body, he said: 'Where art thou going?' She replied: 'I am going to see my father and mother.' He was not at all aware that it was her Là, and she said to him, 'Thou hast a long way to go, let us spend the night together here:' He consented, and to obtain food for their supper, she went and asked it of her children, but they did not see her.

" Though they did not see her, they still had some indications of her presence. While her daughter was beating out paddy, all the paddy suddenly leaped out of the mortar, and a fowl suddenly dropped down dead.

" The man and his wife eat and drank together, and in the morning separated, to pursue their several journeys.

" When the husband got back to his house, he found his wife dead, and his children and neighbours preparing for the funeral. Then the truth rushed on his mind, and he said : 'Children, I met your mother last evening in the road, and we spent the night together. She was going on a visit, but alas it was her Là. Had I but known it, I would have called her back."

Although the body and the Là are represented as matter and spirit, yet in the following story, materiality seems to be possessed by the Là.

" A certain woman sickened and died, while her husband was absent on a journey. While he was returning home, he met her Là on the way and asked : Where art thou going? She replied : 'I am going to visit my parents.' He then slapped her on the face with his hand, and she came to herself again and returned with her husband home.

" When they arrived at their house, they found the people mourning over her body ; but she immediately entered the body, and it came to life again as before."

The Là may be separated from the person to which it belongs during life. In sleep it wanders away to the ends of the earth, and our dreams are what the Là sees and experiences in his perambulations. When absent in our waking hours, we become weak, fearful, sick, and if absence be protracted, death ensues. Hence it is a matter of the deepest interest with a Karen to keep his Là with him ; and he is ever and anon making offerings of food to it, beating a bamboo to gain its attention, calling it back, and tying his wrist with a bit of thread, which is supposed to have the power to retain it.

The forms differ in different tribes, though the thing is substantially the same. A Bghai writes :

" Should a person be often sick ; if he cannot walk without being weary, or work without feeling exhausted ; if he has no appetite for his food ; if he pines away, and has a sallow countenance ; it is said that his Là has left him."

Then his friends take a fowl and a garment of the invalid's, and they spread a mat down at the top of the steps. The garment they place at the top of the steps, and taking a stick with which they stir the boiling rice, they strike the steps, saying:

" Mr. A. B., thy Là has left thee, thy Là has gone away. It is going to and fro; going to the Shans, going to the Burmese; and hence thou art afraid. Thy Là has gone away, and thou art startled, thou art not strong, thou art not vigorous, thou art depressed, thou art heartless, thou hast a sallow countenance, thou hast a cough, thou hast difficulty in breathing, thou art weak, thou art weary, thy head is bald.

' Now Là, I call thee, beat for thee. Here is the great hen-bird, here the great male fowl. Come, *come*, COME. Come and dwell in thy dry place, in thy pleasant location, in thy house, as water tight as the bottle gourd, to thy divan, to thy bedstead. Come and eat the flesh of the female bird, the flesh of the male fowl.'

After the fowl is cooked, the fowl and rice are set out, and the sick man is made to take hold of the fowl's head, when his wrist is tied with a thread, and then the above prayer is repeated. The string is then cut off, the end unravelled, and the cotton pulled from it and scattered on the head of the sick man, with the following blessing:

' Mayest thou live till thy head is white, and thy teeth broken, like this string!'

At the Sgau funerals, the presence of the Là is said to be manifested thus. One end of a slender erect bamboo is attached to the bone of the deceased that has been taken from the funeral pyre. A small thread with alternate tufts of cotton and bits of charcoal, with a metal ring, or bangle, at the extremity is tied to the other end, which makes the bamboo bend down in a curve; and under the bangle, nearly touching it, is a brass bason containing a boiled egg.

The closing ceremony of the bone feast, is calling the Là of the deceased, which is supposed to be hovering around till the funeral rites are completed; when, should it respond to the call, it is bidden to depart in peace to Hades.

When the apparatus has been put in order, the relatives of the dead approach in succession and strike the edge of the brass cup with a bit of bamboo; and when the one that was most beloved touches the cup,

the Là responds by twisting and stretching the string till it breaks, and falls into the cup; or at least shakes and rings against it.

A hundred witnesses could be produced, who have seen it done. Indeed the thread is of such slender material that a very little legerdemain would be required to break it under the weight of the bangle, and the bamboo is so slender, that still less would be necessary to make it spring up and down, and hit against the sides of the cup. But I have watched the whole ceremony, kept the crowd away from the machinery, and there was no more answer to the calls, than there was to the cries of the priests of Baal before Elijah.

Prophets, or Necromancers, are said to have the power of going into the invisible world, and bringing back the Là, when it has wandered away; but the Elders warn their children against unrighteous prophets, who for the sake of gain, when they cannot find the Là of the sick person, will bring the Là of some other person in its place; by which the disease is aggravated.

Thus it would appear that a person may have another one's Là.

The Là is sometimes supposed to take the form or to inhabit insects. Thus when insects are flying around a light at night, the wish is often expressed that the Làs of beasts and demons may be burnt to death, while the Làs of human beings may avoid the fire and escape. Here when an insect flies into the fire, it is said to be the Là of a beast, but when it hovers around and flies away, it is regarded as the Là of a human being.

According to the representations of some, but the idea does not prevail extensively, each person has seven Làs that are constantly devising his death; which is only prevented by a guardian spirit that sits on his head. When that spirit jumps down, the man is lost, for then one or other of the Làs rushes on him and kills him. These Làs seem to be the personifications of evils, natural or moral.

They are madness, epilepsy, lechery, wrath, the exhibition of dreams, the bearer of diseases and languor. "If our mad Là comes, we become insane; if our epileptic Là comes, we are seized with epilepsy; if our lecherous Là comes, we become lost to shame; if our wrathful Là comes, we are filled with anger, malice, and commit murder; if the shower of dreams comes, we are overwhelmed with dreams; if the bearer of sickness comes, we are prostrated by disease; and if languor comes, we feel unable to do anything.

The Là is not confined to human beings; as has been previously intimated, every living thing has its Là. When sitting by the fire at night, and an insect flies into it and is burnt to death, a Karen will say: "There the Là of some animal has leaped into the fire and burnt itself to death. We shall have meat curry to-morrow. The snares and traps have caught something."

Plants too have their Làs; and when the paddy appears sickly, it is said that its Là has been devoured or led away, and it is called back in the following form:

"Là of large grained paddy, full grained paddy, come! If at the forks of the Salween and Sitang, come! If in the west, come! If in the east, come! If in the mouth of the bird, come! If in the mouth of the squirrel, come! If in the mouth of the monkey, come! If in the mouth of the hog, come! If in the mouth of the rat, come! If in the mouth of the elephant, come! If in the mouth of the dove, come! If in the mouth of the sparrow, come! If in the mouth of the porcupine, come! If at the sources of the streams, come! If at the mouths of the streams, come! If in Siam, come! If at Ava, come! If at the corner of the kingdom, at the corner of the land, come! Come, *come*, COME, and dwell in the barn, come and reside in the granary."

Even inanimate things that can be put to useful objects, such as instruments, are supposed to have their Làs. So if a man drops his axe while up a tree, he looks below and calls out: "Là of the axe, come, come."

Looking then at Là in all its usages, it seems to be the personification of the life, or efficiency of a person, or thing.

Departed Spirits.

The spirits of the dead resolve themselves into two great classes. Those who are not permitted to go to Hades, corresponding very nearly to the European notions of ghosts; and the spirits of the ancestors of the Karens, who, on going to Hades, were awarded, on account of their good deeds, a place in the heavenly world, where they exercise a kind watch-care over their descendants on earth. The offerings and prayers made to these beings seem to correspond to the Chinese worship of ancestors.

Ghosts.

The unburied dead.

The Greeks and Romans believed that those who were deprived of funeral rites, wandered about, and were not allowed to enter Hades; so it is no marvel to find this now to be the popular faith in Europe; but it is not a little remarkable to find precisely the same rites prevalent among the Karens.

The Làs of those who have been deprived of funeral rites, the Karens suppose, wander about on earth, and occasionally show themselves to men as ghosts.

The following story illustrates the character of these ghosts:—

"It is related that a man was travelling and lost his way. When night overtook him, he made a fire at the foot of a large tree, and then ascending it, he built himself a little booth among its branches in which to spend the night. Before he got to sleep, he heard the ghosts calling to each other, and, thinking they were the voices of men, he replied to them.

"So soon as the ghosts heard him, one came upon him, and wrestled with him, and was repeatedly on the point of throwing him down, but he had a comb in his hair which in the struggle fell down into the fire below, and the stick-lac in the comb burnt with a very strong smell. This smell made the ghost cough and sneeze, cough and sneeze, till he could endure it no longer, when it ran away, and left him. Had it not been for the smell of the stick-lac, the man would have lost his life, and by this incident we know that ghosts are afraid of the smell of stick-lac."

The sight of a ghost may be obtained by the possession of a skull, or part of one.

"Formerly," say the Karens, "there was a Burman killed by lightning, and a Burman picked up a bit of his skull, and bringing it home put it in the ashes in the fireplace. In the night it became a man, came out of the ashes, and walked about the house, making a noise like the treading of a man, and the wife and children of the man were greatly afraid. In the morning it entered the ashes again, and became a bit of skull bone as before."

Some persons, we are told, breed ghosts. "If a person goes and takes the skull of a corpse, it becomes a ghost, and the possessor can

use the ghost to kill any one with whom he is angry. In the day time, it is a skull, or a bit of a one; but in the night, it is a man. None raise ghosts but wicked men and murderers."

Spirits of those who died by violence.

Another class of ghosts, with a distinctive name, are those who have died violent deaths; "who have been shot, died by the sword, died by falls or drowning; have been killed by elephants or devoured by tigers." The Las of these people do not go to Hades, but remain on earth preying on the Las of men. Hence they are propitiated with offerings, to induce them to free the Las they may have seized. To the previous class of ghosts no offerings are made.

Nearly related to the preceding are the ghosts of wicked men who have been unjust rulers, or who have suffered death at the hands of justice for their crimes. They are regarded as taking the forms of birds and beasts; and when persons dream of elephants, horses, dogs, vultures, Burmans, or Burmese priests, they are said to see these ghosts. Unaccountable sounds and sights in the jungles are also attributed to them.

Varied offerings are made to these last classes of ghosts, of which the following is a specimen :—

After food has been set out for an oblation, the sick is sprinkled with powdered charcoal, and the following prayer is made :—

"Here is property, receive the property, Taluing ghost, Burman ghost, horse ghost, elephant ghost, wild dog ghost, felis ghost, wood-pecker ghost, you call *re re, ro ro* at the foot of the paddy mortar, by the pile of chaff, at the brook, at the place of drawing water. This person going to the bank, going to draw water, going to the new field, going to the old field, you have speared him, you have shot him, you have struck him, you have beat him, you have switched him, you have whipped him, you have beset him. Pluck out the head of your arrow, pluck out the blade of your spear, pot up the wound, heal the gash. Let him be cool as water; let him sleep and be comfortable."

GHOSTS' DOG.

The wood-pecker is said to be the ghosts' dog, and employed to hunt up game for them.

"It is related that formerly two men travelling were overtaken by night in a mountain gorge, where they built up a little booth in which to sleep. After dark, the wood-pecker screamed, and the men heard the ghosts saying to each other: 'The dog barks.'

"Thinking it was other men speaking, the travellers hallooed in reply, when the ghosts said: 'The monkeys are leaping, let us shoot,' and immediately the snap of a bow was heard. Instantly one of the men was seized with a severe fit of shivering; and he went home in the morning and died."

Hence the wood-pecker is a bird of omen, and when a Karen hears it scream, he cries out: "Wood-pecker, shun me afar off. Shun my house, shun my road, shun my way, shun my field, shun my garden, shun the roof of my house, shun my place, shun my stream, shun my brook, shun the place where I draw water. Shun me, keep afar off, go thine own way, thine own road."

Spirits of Ancestors.

The Karens suppose that their parents who have performed meritorious acts go to a place of happiness above, which seems to correspond to the Deva heavens of the Buddhists. The existence of God the original Creator of all things is quite ignored, and he appears to have no place in it. It has its rulers and its subjects; and one of the names applied to them is the Burmese designation of Indra, the king of the Deva heavens.

These beings are supposed to preside over births and marriages, and to exercise a general watch care over their children on earth; and the Karens make offerings to them, as their deified ancestors.

There are different classes of worshippers or sects, as they may be denominated, who make different kinds of offerings. One set of worshippers offers only rice and vegetables; another offers fowls, another hogs, and another oxen or buffaloes. Those who sacrifice animals, sometimes offer all three as different rites, but those who offer rice and vegetables never offer sacrifices.

These different rites are hereditary in different families of the same or of different tribes. Those whose ancestors offered bloodless offerings, offer bloodless offerings; and those whose progenitors sacrificed animals, sacrifice animals.

In the Tenasserim provinces, none are found who sacrifice oxen or buffaloes. At Toungoo, I have not met with those that offer only rice and vegetables; and among the Red Karens, the Bghai rite in which a hog alone is sacrificed is unknown.

There is much confusion in the minds of the Karens in relation to the character of the beings addressed, and contradictory statements are made by different tribes, and by different individuals of the same tribe, and much diversity prevails in the forms and prayers.

The following is a Sgau prayer, when offering a fowl:—

"Mothers and fathers, The-klu, I will offer you a great cock with a spur fit to stick a rice mortar upon. Take away sickness, take away disease, take away laziness, take away inefficiency, take away sleepiness, take away drowsiness, take away inability to obtain, take away inability to make a living, take away unsuccessfulness, take away want of success, take away debasedness, take away wretchedness, take away the whole."

The Bghai forms, given below, are used when the sacrifice is a hog, but the Bghais do not seem to have any definite ideas of the Beings to whom the offerings are made; much less so than the Sgaus. They require that the officiating priest shall be a woman, the oldest of the family. The husband has nothing to do in the matter; the woman and her relatives are the only parties concerned. If the husband is rich, he has to look to his own relatives to make the necessary offerings for him, in which he joins. A Bghai writes:

"The first thing is to brew or distil spirits for three days. Then a little table is made with four bamboo posts. Leaves of a plant of the ginger tribe are next rolled up in a sugar loaf form, and three joints of bamboos are cut off even. Spirits are then poured into these three bamboos, and the conical rolls of leaves with bamboo bottles of drink are all set upright on the table. Then a living hog is put on a fanning basket.

"The head of the offering, or priest, is a woman, and she takes one of the conically rolled leaves, and, turning to the table, she prays to Yau, as if he were present there. She prays thus:

"O, Yau-peu, thou dost now devour the whole family. We feed hee with old spirits, and a great hog. Heal us, watch over us, defend us. When we fall, raise us up; when we slip down, set us up

again. Make us strong, make us vigorous; all of us. When we fall on the wood, hew it through; when we fall into the coffin, split it open, [*i. e.* raise us up from the point of death]. Establish us, make us immoveable. Let not plots, let not devices against us succeed. Let us have large crops, let us have good paddy. Let us have little grass, let us have few weeds. Let our labour be light, let us eat whatever we want. Let us succeed in our works; let us eat with little work. Let the effects of our labours increase, let our produce swell up, like rice in boiling. Let us ascend to the tops of the mountains, let us descend to the depths of the valleys. Let us spear hogs, let us seize captives. Let us purchase kyee-zees, let us dig out the pangolin, [*i. e.* let us accomplish difficult things]. In the water, let us be great rocks; on land, let us be large wood-oil trees. Let not the tiger seize us, let not the tiger kill us. When the tiger would leap on us, may he growl; when man would seize us, may he cough. When tigers would leap on us, may they wait for each other; when men would seize us, may they feel abashed. Let us devour a stream to its source, let us eat a creek to its mouth, [*i. e.* get possession of the whole valley]. Let us eat up the rock to atoms, let us eat the sand to dust, [*i. e.* overcome every difficulty]."

The priestess next lays her left hand on the neck of the hog, and with her right, she grasps the hand of the oldest person in the company, and shaking it slowly up and down, she repeats the above prayer. In this way, she goes round the whole company from the oldest to the youngest, repeating the prayer with each.

The hog is killed next, but it is not killed with a knife or spear; but a sharpened bamboo is forced into it on the right side, under the fore leg. When the bristles have been singed off, a part of the flesh is cooked with rice flour in a chatty, and a part in joints of bamboo; but the head is hung up whole on the posts of the table.

When the rice and meat is spread out, the priestess shakes hands again with each one, and prays as before. She then tastes the food, and after her the others taste it in succession, from the oldest to the youngest.

This done, they rise up, and the priestess tastes the spirits; and, as before, all the rest follow her example according to seniority. After this they all return to the food again.

At evening, the stomach of the hog is roasted, and all taste of it, in the manner described above.

Next morning at dawn, they take the posts of the table, and throwing them away endwise, as they would throw a javelin, into the earth without the village, they say: "Now it is done, it is finished. Go thy way, return to thy place."

After it is light, they cook the head of the hog, and eat it with any meat that may be left. On that day the people do not go away from the house.

Witches and Wizards.

Next in order to the spirits of the departed dead, in Karen mythology are their witches and wizards; but witches, among the Karens, are not persons who have made a compact with Satan, as European believers in witchcraft suppose, but persons possessed with a demon which they call *Nà*, and the Red Karens *Ne*. The name does not correspond to the Burmese *Nat*, as some have thought, which denotes an entirely different being, but is equivalent to the Burmese *Sung*.

According to one myth, the Nà is an animal that God commanded man to eat at the beginning, with other animals, but neglecting to do so, it became invisible and now eats him.

According to another legend, it is a human stomach; those possessed of Nàs having stomachs, while others are destitute of that organ. One story represents a woman, who had incontinently married a man possessed of a Nà, as saying: "I saw his stomach under his finger nail, but thought it was an insect."

One man, with a Nà, was observed when asleep to be without a head, and to eat and breathe from the top of his neck. These are headless demons in the Hindoo mythology.

A person possessed of a Nà is said to devour people, but it is the Là, or vital principle that it devours, not the body. When it eats the eyes of another, the eyes remain, but they are blind; the matter is left, but the life has gone.

Sometimes the stomach is represented as going about devouring men, but more often the act is attributed to the person. One possessed by a Nà sees men as beasts, and their eyes as fruit.

In one story, a young man had married a woman with a Nà, and

soon after marriage, she was seized with an intense longing for glittering fruit." He brought her all the fruits he could find, but none were of the right kind; and she sent him off to her mother, who lived in another village to ask her for some. Her mother said she knew what her daughter wanted, and told her son-in-law to go and visit the neighbours till she procured some for her. The old woman then went to pounding rice in a mortar before the house, when the children, who were playing around, came up, peered down into the mortar and said: "Grandmother, what are you pounding here?" and as each one looked down into the mortar, an eye dropped in, and the children were suddenly struck blind. After she had thus obtained a sufficient quantity, she gathered them up, put them into a hollow bamboo, and sent them to her daughter by her son-in-law, with the charge that he should not unstopper it and look in by the way. He did, however, when half way home, pull out the cork and look in, when he saw the eyes rolling about, and some of them jumped out, of the bamboo; and the eyes of the children that escaped were restored to sight again. Those that remained he carried to his wife, who devoured them with great relish.

Human beings often appear to a person possessed of a Nà as rats, and are devoured as such. In one story a man is represented as going to the field, followed by his child, and on reaching the foot of a large tree, the power of the Nà came upon him and he devoured his little boy, thinking him to be a rat. He then returned to his house, and brought back with him his other child, which he devoured in the same place that he had eaten up its brother. He next went and brought the mother to the scene of his former barbarities, but left her there a little while to look for a club to kill her. In the interval, a lizard in the tree that had witnessed the death of the children, told her what had occurred, and drew her up the tree out of her husband's reach. When he returned, and could not get at his wife, he was so enraged that he began to devour his own flesh, and eat up his arms and legs close to the body.

A person possessed of a Nà has the power to take the form of another. In one story, an old man asks his nephew in the morning, why he came and shampooed him so severely during the night. The nephew declared he had not been near him, and gave his uncle a sword

to smite the visitor if he came again. The next night, the supposed nephew was at the old man's bedside again, and his uncle looked at him from head to foot, and he seemed to be his nephew so accurately in every part, that he could not use the sword against him. In the morning the nephew called, and asked if he had cut down his visitor. "No," he replied, "he was from one end to the other so exactly like thee, that I did not dare to strike him." The young man sharpened up his sword and made his uncle promise to cut down the man when he came again without hesitation. This he did, and struck off his head at a single blow, when he immediately disappeared. Next morning it was reported that a man had died in the village during the night, and when the nephew went to look at the body, behold it was headless; "so he then knew that a Nà had attempted to devour his uncle."

The interchange of persons is sometimes represented as a change of skins. It is related that—

"Anciently there was a woman possessed of a Nà whose name was Po-kla, and she was as black as a crow. She would exchange skins with other people; and when she met with a woman with a white skin, she would put on the white skin and clothe its owner with her own black skin."

In one story she is said to be the black slave of a young man of property that went abroad and brought home a handsome white wife. Soon after his return, Po-kla succeeded in exchanging skins with her mistress, and took her place as her master's wife, without her master suspecting the change. The mistress was now beaten and cruelly used by her former slave.

At the time of early paddy, she was sent into the field to drive away the birds; when all the doves and little birds came around her daily. She charged the birds not to eat the paddy, and she had no occasion to run after them, for they remained with her in the booth all day long. She ordered the dove to go and bring her fragrant oil from her grandmother's house; but when the dove reached there, she broke her wings, and for a long time she was unable to return. So soon, however, as the wings healed, she picked up the bamboo joint, which contained the fragrant oil, unobserved, and flew away with it to her mistress. Her mistress anointed herself with the oil, and became herself again, and even more beautiful.

She then went and told her husband that she was his true wife and the other woman his slave, as he might know by looking at her tongue, which he would find to be black. It was found difficult, however, to obtain a sight of. her tongue, for she was aware of the consequences. All attempts to make her laugh failed, but they struck her suddenly, when she screamed and exposed her tongue, which was seen a jet black. Her master then slew her with the sword.

Then he wished to live with his true wife again, but she said he had defiled himself by his connection with the black slave, and she would have nothing to do with him, till he had steeped himself in water seven days and seven nights. He agreed to do the prescribed penance; but after he had been in the water one day and one night, he was almost dead with cold, and could scarcely speak, so his wife had compassion on him, took him out of the water, warmed him by the fire, and lived with him happily ever afterwards.

The sensation in sleep, called "night mare," is produced, the Karens say, by a Nà being seated on the region of the stomach; an idea very analogous to that received anciently in Europe of its origin.

Such an evil influence is supposed to emanate from persons possessed of Nàs, that their praise is deemed injurious to the person or thing possessed. If one looks on a piece of grain and says: "This is a very fine field;" the grain withers, and becomes sickly. If he says to a parent: "You have nice children;" the children become sick and perhaps die.

Hence it is not always safe to praise the Karens or their possessions; for if any accident happens to them subsequently, there is great danger that the person who praised them will be reputed a Nà.

The belief in the existence of these Nàs is still very strong, and the persons who possess them are deemed worthy of death.

A few years ago, two young men appeared before a Karen Goung-khyruk in Mergui with a charge against a man of having a Nà. The magistrate's reply was of such a character, that they immediately went and killed the man in open day.

Lords.

In Karen mythology, every natural object has its lord or god in the signification of its possessor or presiding spirit. There is not only

a lord of the earth, but there is also a lord to every country and land and district.

Lord of the Earth.

The lord of the earth appears to be confounded with the king of Hades, and clearly comes from the Hindu pantheon, but probably through the Buddhists. The Sgaus furnish the following account of him :—

"The lord of the earth existed at the creation of the world, and the elders say, he rules over the whole world. If we go to a distant region, and swear or use foul language, he makes the tigers devour us, or the serpents bite us, or brings sickness upon us. Hence, if we go to another district, or into the jungle, we are afraid to speak unadvisedly, or to use bad language. We fear the lord of the earth will hate us. Therefore before we eat, we offer him a little of our food, and pray : 'Lord of the earth, eat first and preserve us, O lord !'

"If we transgress in our language, while in a distant land, the lord of the earth will kill us before dark ; but if we are in our own country, and are guilty of swearing or using indecent words, we make him an offering and pray : 'We are dark ignorant people. Whatever transgressions we may have been guilty of in our words by swearing or obscenity, do not, O lord, set against us. We will make offerings to thee annually, every year. If we do not die, your lordship shall eat of our food continually and of our children's food, generation on generation.'"

The spirits which are denied admittance into Hades and are condemned to become evil spirits on earth, are regarded as the servants of the god of the earth, and employed to execute his orders.

Among the Sgaus in the south, an annual festival, usually in January, is observed, for making offerings to this god and his followers.

The Bghais observe a similar custom, but it is varied a little. Once in three years is the usual period for its performance ; but in calamitous times once in two years, while a succession of good crops and general prosperity will delay it to four or five years. The Bghai festival is held, when the paddy is well up, about the month of July.

As the rite has been described to me, the first thing done is to take a hog to a central position in the village lands, and placing it

under a Eugenia tree, there erect a booth. The Eugenia is chosen because regarded as a more holy tree than any other. The booth is for the "four heads of the sacrifice," or priests, and elders to occupy.

When the booth is built, every man cuts three bamboos, one long one to represent a post in his barn, and two short ones which he ties to the long one, to represent the height to which he wishes his crop of paddy to reach when it is gathered into his barn. Then he makes in miniature, a paddy bin, a long pen, a hen coop, a trap, and a snare.

When these preparatory measures have been taken, one of the heads of the sacrifice calls the people together, and all the men assemble about the booth. The most wealthy elders sit together with "the heads of the sacrifice" in the booth, but the young people and the poor stay without. No women are allowed to be present.

The ceremonies are introduced by "the head of the sacrifice" taking a small branch of the Eugenia tree in his hand, when all present imitate him and take a leafy sprig of the tree. The leader lifts his clasped hands to heaven with the sprig between them, and prays; when all follow his example, each asking in his prayers for whatever he most desires.

After the prayers, the head of the sacrifice rises up, and taking a spear, spears the hog to death. So soon as the blood begins to flow, all the people jump up, and each one seizes his bamboo which had been set against the tree, and calls out with a loud voice: "May my barn be filled with paddy as high as my bamboo!" Some cry out, "I have caught many rats in my trap;" and others: "I have snared many wild fowls in my snare." Some dance with shields that they have prepared for the purpose, and others beat drums, and blow pipes.

They next take the hog to the village, and every man, young and old who is able, kills a fowl; and after they have cooked the hog and fowls, and prepared the food and drink properly, they carry the whole to the booth. There they place the food on a raised platform prepared for the purpose, and taking again sprigs of the Eugenia tree between their clasped hands, they all pray, saying:

"Lord of the seven heavens and seven earths, lord of the water, lord of the land, Thie-kho-mu-kha, all of you, eat our property, eat our pork, eat our fowls, make our paddy good, our rice good, make

our daughters handsome, our sons skilful; give us food, give us drink, give us to become governors, give us to become elders; enable us to buy kyee-zees, to spear with fatal effect; make our names famous, heard above and below; make us joyous and happy with our wives and children."

After praying, they rise up and dance again. When the dancing is done, they set the food in order in the booth, to remain there all night, as not a bit of it is to be eaten before the next day, and then return to their houses, dancing all the way home. The remainder of the day is spent in their houses, drinking, dancing, and beating kyee-zees and gongs.

The next morning they all repair again to the foot of the Eugenia tree, when the heads of the sacrifice and the elders commence eating the food and drinking the spirits that have been prepared and placed in the booth. All are allowed to partake that choose, but the food is considered holy, and none but the holy, clean, and upright persons are considered as proper persons to partake of it. The question of fitness is left, however, for every one to decide for himself. If a man feels persuaded in his own mind that he is guilty of no transgression, but is upright and holy, he goes forward and partakes of the food; but if his conscience reproves him for some wrong deed or word, he joins the throng outside the booth and occupies the time with others in dancing. Nor is unfitness to partake of this holy food confined to immoral acts. There are certain ceremonial uncleannesses which are regarded as unfitting a man to partake. For instance, if a man's wife is pregnant, he is deemed unclean, and unfitted to eat of this holy food.

After the feast is finished, the company returns to the village, dancing all the way as before; and on arriving at the houses, one or two of "the heads of the sacrifice," go to the brook and draw two bamboos of water for every family in the village. After the water has been drawn, "the heads of the sacrifice" call all the members of each family to the hall or verandah; men, women, and children, and then he sprinkles or throws the water from one bamboo upon them. Those who get wet are said to be free from evil, because the water is "holy water." One bamboo full remains in the house till next morning, when the owners go to the fields, and sprinkle it on their growing

paddy; and they say, because it is "holy water," the paddy being wet by it will be good and abundant.

In all these ceremonies women are carefully excluded, except in participating of the "holy water."

The four elders that are called "the heads of the sacrifice" or priests, have special names or titles given them to distinguish their office.

The	first	is called	Deu-sai,	*i. e.*	Lord of the village.
,,	second	,, ,,	Pghai-sen,	,,	The Messenger.
,,	third	,, ,,	Ywa-san,	,,	Keeper of the village.
,,	fourth	,, ,,	Sa-kai,	,,	Signification uncertain.

These offices are strictly hereditary. The fathers of the present occupants held them, and their places, when they die, will be held by their sons.

When the priests officiate, they have embroidered tunics given them by the people. Sometimes they are embroidered with silk, and often with red silk, and are made longer than ordinary garments. The people give them also ear knobs and beads, and think that it is very meritorious to do so.

Some villages offer a cow or bullock instead of a hog, and one of the Mopaha villages near Toungoo were always in the habit of seeking a black bullock for sacrifice. Their desire was for one perfectly black, without a single white or red hair on it; and for such an animal they would give almost any price.

Goddess of the Harvest.

Another distinguished character is an old woman called grandmother Bie-yau, who presides over the paddy. She seems, from the account given of her first appearance, to have been originally a serpent, and is now a widow.

"It is said, that in former times, a certain person cultivated paddy, and grandmother Bie-yau with her husband took the form of two pythons and wound themselves around his pile of paddy, when the paddy increased enormously. The owner of the paddy ignorantly killed the male snake and the female ran away, but she cursed him saying: 'We came in compassion and helped thee with so much paddy, and thou hast killed us! May thy three barns of paddy last only three months!' His paddy was done in three months, and the

owner had to borrow money to buy more, that he might live; and he finally became a slave."

Offerings are made to her in a little house built in the paddy field for her residence, in which two strings are put for her to bind the Là of any person that may enter the field. The following prayer accompanies the offerings:—

"Grandmother, thou guardest my field, thou watchest over my plantation. Look out for men entering; look sharp for people coming in. If they come, bind them with this string, tie them with this rope, do not let them go. If they will pay fines of money, do not let them go; if they will pay fines of silver, do not let them go; but if they will pay fines in piles of paddy, barns of paddy, dismiss them. Eat, grandmother, guard my field, watch over my plantation. Pour down thy children's rice and paddy, grandmother, or thy children's fields will come to nought, sweep it off with thy hand, bring it down continually."

At the threshing out of the paddy another form of prayer is used as below.

"Shake thyself, grandmother, shake thyself. Let the paddy ascend till it equals a hill, equals a mountain; ascend as high as Mount Than-thie, as high as Mount Pshan-ghau; ascend and become a conspicuous object, ascend and become a distinguished object; ascend and look at the sun; ascend and look at the moon; ascend and look at the heavens, ascend and look below the earth. Let my paddy pile, grandmother, be as large as a mountain. Shake thyself, grandmother, shake thyself."

Goddess of Fortune.

There is a divine female who dwells on the summit of Than-thie, the highest mountain known in Burmah, who spends all her time in blessing and cursing. The elders said: "If she curses the leaves that they may fall, they fall; if she blesses the young leaves, they sprout. If she curses the trees to die, they die; if she blesses them to live, they live. Every thing, the elders say, takes place according to her imprecations."

When the long-armed apes are heard screaming at night, it is said they scream on account of having heard the imprecations of the goddess Tà-là, the name given to this lady. The apes on Than-thie, at the

south-east corner of Toungoo, hear her words and cry, and the language is taken up by all the other apes within hearing, and is thus passed on from one to another throughout the whole land.

Thunder and Lightning.

The thunderbolt is regarded as a living being. It has been seen and described by the elders as tearing up trees in the form of a hog, and about the same size, but with bat-like wings. When it utters its voice, it thunders, and when it flaps its wings, fire is produced, and it lightens.

When it lightens in the evening near the horizon, and no sound is heard, it is said that the young thunderbolts are flapping their wings, but they are not old enough to make a noise so as to be heard far.

Rainbow.

The Rainbow is deemed to be a spirit or demon, but the people are not united in regard to its true character. Some say it is a woman who died in pregnancy; others, that it is a demon which devours the spirits of human beings, and then they appear to die by accidental or violent deaths; and other theories are propounded.

" The Rainbow can devour men," says one. " When it devours a person, he dies a sudden or violent death. All persons that die badly, by falls, by drowning, or by wild beasts, die because the Rainbow has devoured their ka-la, or spirit. On devouring persons it becomes thirsty, and comes down to drink, when it is seen in the sky drinking water.

" Therefore when people see the Rainbow, they say: 'The Rainbow has come to drink water. Look out, some one or another will die violently by an evil death." If children are playing, their parents will say to them: 'The Rainbow has come down to drink. Play no more, lest some accident should happen to you.' And after the Rainbow has been seen, if any fatal accident happens to any one, it is said the Rainbow has devoured him.

Naiads.

The waters are inhabited by beings whose proper form is that of dragons, but that occasionally appear as men, and who take wives of

the children of men. Unlike the Naiads of classic antiquity, they never take the forms of females, but always appear as men.

One girl, who had been deceived and had taken an inhabitant of the water for her husband, was told that she might ascertain his true character by watching him privately when he bathed. She did so, and saw him in the water change to a monster dragon, with a crest as large as seven wide mats. He threw up the waters to the heavens, which descended in heavy rain.

A water spirit called *Mau-lau-kwie* figures largely in the Karen myths. A girl is represented as having formed an acquaintance with this personage, and as holding clandestine meetings with him, when she went down to the stream to draw water. Standing on the bank she sung :

> " Mau-lau-kwie, come, let us bathe together.
> Mau-lau-kwie, come, let us wash our faces together.
> Mau-lau-kwie, come with beads and rings;
> Come, come, as thou art wont."

" Mau-lau-kwie came, and they washed their faces together, and combed their heads together."

This occurred frequently, and the girl's parents wondered at her long absence, when she went to draw water; so they sent the younger children to see, and they came back with the report that their sister had a meeting with Mau-lau-kwie. Her father then sent her off to help her grandmother, and in the interval he went down to the water and called Mau-lau-kwie, as his daughter had done. He came at the call, when his father-in-law cut off his head with a sword, and split open his head with an axe.

When the girl returned from her grandmother's, she went down to the banks of the stream, and called her lover as usual; but instead of Mau-lau-kwie, there came a long procession of tadpoles, crabs, cray-fish, shrimps, prawn, fish and crocodiles. She asked : " What does all this mean? Where are you going?

" A crocodile replied ; ' Mistress, we are going to weep at the funeral of Mau-lau-kwie,

> His father-in-law cut off his head,
> Split open his skull;
> Mau-lau-kwie is dead, is dead."

" She answered : ' I will go with you.'

"'The crocodile said: 'Thou canst not go;' but she replied: 'I *will* go.'

"The crocodile then said: 'If thou wilt go with me, prepare seven cakes of bread, seven chatties of steamed rice, seven hams, and seven white cloths.' She made the requisite preparations, and started off with the crocodile. The crocodile said to her: 'When I wriggle my body about, throw down a cake, a chatty of steamed rice, and a ham.' She went along, and fed the crocodile as he directed; and they reached the body of Mau-lau-kwie, where she wept and sung:

> 'There is no one to build the house,
> There is no one to build the dwelling;
> The flying squirrel's wings are split unequal.
> Would that I had died with my husband.'

At this juncture Mau-lau-kwie rose to life again; and, on uttering a word, the tortoise said *Yà-lau;* when Mau-lau-kwie, exhausted, fell down, and hit against the breast of the tortoise.

Again they wept for Mau-lau-kwie, and when his wife sung, again he rose to life, and spoke a word; but the flying squirrel said Yà-lau, and Mau-lau-kwie fell against the flying squirrel, and tore his wings unevenly. Again they wept, and again his wife sung, and Mau-lau-kwie rose to life again; and now to die no more.

After Mau-lau-kwie's wife had born a child, the family went to visit her parents; and one day she went out to visit the neighbours, and left the child in charge of its grandmother; saying to her: "Mother, if the babe awakes, do not bathe it in the brass bason."

After the mother had gone out, the child awoke, and its grandmother put it into the brass bason to bathe it, when it turned into a little yellow-tailed carp. The old woman broiled it, and when her daughter returned, told her what had happened, and what she had done. The mother took the fish, went down to the stream, and threw it into the water. Her sister followed to weep with her for the loss of the child, but the mother ran down the bank on the crooks of the gigantic bean creeper, and she did not dare to follow, but stood weeping at the top of the steep bank. Her father came and asked her, what she was crying for; and on hearing, he cut off the vine in anger; and it fell down into his son-in-law's great hall and filled it up.

His daughter called out: "Father, thou hast given me up now. Thou hast cut off the gigantic creeper, and I can no more visit thee." Her father heard these words, and he also heard his grandchild.

"I visited grandmother, I visited grandmother; grandmother gave me an egg to eat: I visited grandfather, visited grandfather; grandfather gave me a fowl to eat."

He heard the voice of his daughter and the voice of his grandchild, and he dived down into the water time after time all day, but found nothing, and returned home at eve sorrowing.

Dryads and Oreades.

The elders relate that Mount Kie-ku, in the Bghai country, and the peepul Tha-ka-u beyond the seas engaged in war.

It arose on this wise. The peepul had a daughter whose name was Bu-ban, and the mountain had a son whose name was Phai-thau-o; and the two were married. After the marriage, she came and lived with her husband's family.

She was possessed of miraculous powers, and did not pound paddy. She would take a single kernel of rice, and split it in two, and then throw one half into the rice bin when it was filled with rice immediately, and the other half she threw into the rice chatty which became filled with rice in the same manner.

Her neighbours were envious, and mount Bai-tha-lu seized her, and gave her to mount Po-phau; and mount Po-phau gave her to mount De-pha-ho; and mount De-pha-ho put her in the stocks, which still remain. There she sat, and wept, and blew her nose; and the marks of her finger nails, where she wiped her hand on the rocks, are yet visible.

The peepul, Tha-ka-u, became very angry with mount Kie-ku on account of treatment his daughter had received, and made war with him.

The peepul being in the sea, made the crocodiles his soldiers, and mount Kie-ku's soldiers were thunderbolts. When they fought, the peepul made the waters rise, and soften the earth, and the crocodiles thrust their tails into the ground, so that the sides of the mountains slipped down. At each land slide, they would say: "There dies an officer."

When mount Kie-ku attacked, he made it so hot that the sea was dried up, and the crocodiles could not live in it; and he threw his thunderbolts at the peepul, and when a branch was struck off, they said: "There dies an officer."

The peepul came and fought the mountain several days, but getting the worst of it, he said: "I will retreat." In his retreat Phai-thau-o, his daughter's husband, intercepted his path, and hid himself in a gorge by the way, watching for his father-in-law to come along. He had a sword, and a gold comb that shone like the sun, and to keep himself from being seen, he put his comb under his foot and trod on it. There he stood in the interstice of two rocks, and when one of the peepul's officers came along, he smote him with his sword and killed him; and so on, one after another, till he had nearly killed off the whole. There was only one left. He said to himself: "They are all ended, and took up his comb, and put it in his hair again, which made him visible.

The remaining officer said, as he came along: "A great many people have gone before, and yet the sound of horse or elephant is not heard;" and starting on, he saw Phai-thau-o, whom he cut down and killed with his sword.

Until this day, people say the matter is not finished. They have a saying: "Mau-khe's contention is not settled: Mau's contention is not settled."

Brownies.

Now and then, we find a good natured spirit appearing in Karen stories that comes for some one's benefit. Here is a specimen:

"The elders say that there was once a poor orphan boy, that owned nothing but a dog with seven tails. On one occasion, he noticed his dog go and bark on a hillock in the field near his house; but when he went there, he found nothing, so he came away. Still the dog remained barking, and he went again and dug into the hillock, when he found a cavity with an egg in it. He took the egg, intending to eat it, put it in a basket, and went to work in his field. During his absence, the spirit in the egg cooked the poor youth's rice and curry for him; and when he came home, he found his meal ready prepared for him, but he was afraid to eat it, and he went to the neighbours to inquire if they could explain the matter. They

replied to him roughly : 'Thou art an orphan, thy house is nasty and dirty, who dost thou think would go up into it?' He returned to his house, and being very hungry, he said to himself: 'If I die, I die, I will eat.' So he ate, and nothing happened to him.

"The same thing occurred next day. His food was cooked and ready for him on returning from his labour. The following day, he determined to watch; so after going away, he returned cautiously, and he saw a young woman come out of the basket. She went to the brook and brought water, and then cooked the rice. He showed himself to her, and she no more took the form of an egg, but became his wife. She said to him: 'My name is Miss Egg, but never speak my name. If thou dost, I shall disappear, and thou wilt see me no more.'

"People frequently asked him for his wife's name, but he never told, till they induced him to drink arrack to intoxication. Then he revealed her name. When he came to himself his wife was gone, and he wept bitterly.

"His dog said to him: 'Master, don't cry.' We will go to where Mistress is.' He answered: 'If we go, shall we find her?' The dog said: 'Follow me.' So away they went together, till they reached the banks of the Salwen, when the dog said: 'I will swim across. Take fast hold of my tail, and on reaching the other side, do not say: 'Good.' If thou dost, my tail will drop off.' He failed, however, to do as he was commanded, and on getting on shore he exclaimed: 'Good!' when one of the dog's tails dropped off.

"They kept on their way, till they reached another large river, where the same scene was enacted; and so on, till they had crossed seven large rivers and all the dog's seven tails had dropped off. On losing the last, the dog said to his master: 'I shall die, and there are many cross-roads on the way. If master goes on, let him take my body with him. On reaching the first crossings, cut off my head, and try on which road the blood drops. Follow the road on which my blood drops; and on coming to a multitude of houses, try the foot of the steps of each house till my blood drops down on one. The house in which my Mistress lives, is the one on which my blood drops upon the steps.' The dog ceased speaking, and immediately expired. This time the man followed his dog's directions, and found his wife."

Feticism.

The Karens, in some of their observances, come very near to the worship of "stocks and stones." Many keep stones in their houses that they suppose possess miraculous powers, and which seem to represent the household gods of the ancients.

A Bghai writes:

"The elders say: Some stones are possessed of superhuman powers, and if we possess them, we shall succeed in our undertakings, and obtain a sufficiency of food. If we possess but a little, that little will not be expended by using, but will always be enough to supply our wants.

"Some stones are called paddy stones, because those who possess them, obtain good crops of paddy. Some stones are said to make us invulnerable; so that when javelins are thrown at us, spears thrust against us, or blows aimed at us with swords, we shall not be hit; or if hit, they will not enter our flesh.

"These stones crave blood. If we do not give them blood to eat, they will sometimes eat us. So people kill hogs and fowls, and then pour the blood into a vessel, and put the stones into the blood.

"If the stones are thrown away, after a considerable time, they will be sometimes found to have come back again to their old accustomed places.

"In a village of thirty families, perhaps ten will have these stones; but in some villages nearly every family will have them. They are sometimes bought and sold, and those that are reputed good ones, will sell at from thirty to fifty rupees. Some that have been in a family a long time, the owners dare not sell. If a stone is sold at less than its real value, or is stolen, it will return to its former owner.

"We have heard that the inhabitants of the village of Deu-mu-kha had a number of stones, the principal one of which they called Lwai. No one dared to touch or even look on these stones, excepting the officiating priests in the sacrifices to the lord of the earth. They had charge of the stones, and were called their lords or masters; and when a black bullock was sacrificed to the lord of the earth, a fowl was sacrificed to these stones in the same place.

"It is said that the Burmese on one occasion made an attack on

this village and carried away all their stones; but afterwards all the stones came back to their old places.

"When the teacher arrived, they carried away all their stones into the jungle, and built a chapel, and said; 'If the stones come back, we will not worship God, but if they do not come back, as formerly, we will worship God.' The stones have never returned, so the people worship God to this day. The inhabitants of that village stand in great fear of stones, more than ordinary.

"We have also heard that the Pakus have stones, like a man's fist, and when they have any hatred against any one, they will strike the impressions of his foot on the ground with one of these stones, and the man dies."

I have seen many of their stones, but there is nothing remarkable in them, and they possess nothing in common. They are most usually bits of rock crystal, or jasper, or some variety of chalcedony, but never of any value, or in any way curious. Occasionally they are mere lumps of stratified rock, remarkable for nothing but the numerous thin lines of strata displayed on their edges.

The possession of one of these miraculous stones had much to do in dividing the Red Karens into two tribes, eastern and western, as they are now found. The story has been related to me thus; "There was a Sgau called Shapau, who possessed an exceedingly good stone. He set himself up as a kind of political teacher, and travelled about from village to village among the Sgaus and Pakus. They said to him, 'We cannot receive thee. If we receive thee, should the king at Ava hear of it, the Burmans will kill us all.'

"As he could not succeed among his own countrymen, he took his wife and wife's sister, and went away to the Red Karens. They received him and built him a house, and it was not long before he began to work miracles with his stone. The stone was remarkable, it is said, for having the power to change its colour. It could change from black to yellow or white at pleasure. The result was that all the Red Karens believed in him. They believed in him so fully that they were discussing the question of making him king.

"At this juncture, a son of the king of Ava rebelled against his father, but his father overcame him and he fled to Toungoo. He did not dare to remain long there, however, for fear of his father, so he

went into the Red Karen country, where he met with Shapau, and married his wife's sister. In the end, the Burman succeeded in establishing himself in the eastern part of Karenee, killed his brother-in-law Shapau, stole his stone, and became king or chief of all the eastern part of the Red Karen country, where his descendants rule to this day."

Magic.

Karens believe in the magical properties of things, as illustrated in the following story:—

The Magic Ring.

"The Elders say, there was an orphan child brought up by his grandmother, who was so lazy that he would not open the skins of the wild plantains when he wanted to eat them, but made his grandmother do it for him. He would do nothing but play, so he got the name of Mr. Laziness.

"His grandmother, finding a trading boat going down the river, persuaded the boatmen to take him along. When on board, he would not do anything. If the boatmen gave him food, he ate; if they gave him none, he fasted. They found him good for nothing but to watch their boat when they left it; and for this they gave him an occasional two annas or a quarter of a rupee.

"One morning, when all the men had gone up into the town, and he was left alone in the boat, he heard that one of the citizens was about to kill a cat, and he asked permission to buy it, and it was sold to him.

"Again, about noon, he heard that another one was going to kill a rat, that had done some mischief, and he bought off that also for three pice.

"Towards evening, several of the citizens came along with a crocodile, that they had just taken, and were about to kill, for having devoured several men. This, with a dog, he bought for a quarter of a rupee. He put the crocodile into the boat, when it spoke and said to him: 'Master, thou hast had mercy on me and bought me, and I shall not die. The reason I devour men is, that there is a gold ring in my head. The ring is under the flesh in my head, and whatsoever I desire, I obtain. Chisel it out, take it for thyself, and let me go into the water.' So he took a chisel belonging to one of the boatmen,

cut the gold ring out of the crocodile's head, and let it go free in the water.

"He put the gold ring on his finger, and when he desired silver, silver came into his box; and when he desired gold, gold came into his box. The boatmen came back to the boat at night, but knew nothing of what had happened; and he returned with them to his home.

"He told his grandmother to go to the king of the country, and ask his daughter in marriage for him. She said: 'Dost thou want to be killed by the king's sword?'—and refused to go. He replied: 'If thou dost not go, let thy arm come out of the back,' and immediately her arm come out of her back. Being unable to withstand her grandson, she finally went to the king, and asked his daughter for him.

"The king said: 'Let thy grandson build a bridge of silver, and a bridge of gold from the foot of the steps of your house, to the foot of the steps of my palace, and then he shall have my daughter in marriage; but if he does not, then you shall die.' The old woman returned weeping, but when she told the king's terms, he bid her cheer up, for he could easily comply with them.

"During the night, he desired a silver bridge and a golden bridge to stretch itself between his house and the palace, and it was done. So in the morning the king led his daughter over the golden bridge, and gave her in marriage to Mr. Laziness.

"There was a Brahmin at court, who came to the princess, and said: 'Thy husband wears a gold ring, and he will not allow thee to put it on thy finger.' She replied: 'If I ask him, he will.' So she asked her husband to allow her to wear the gold ring, and he at once granted her request.

"When the Brahmin saw the ring on her finger, he asked to see it; and she handed it to him. Immediately he put it on his finger, and exclaimed: 'Fly away, fly away palace;' and the king's palace flew away to the other side of the ocean with the Brahmin and the princess in it.

"The king said to his servants: 'Because I received Mr. Laziness, I have lost my palace, go put him in prison, and to-morrow go and kill him.' The king's servants went and put him in prison.

"He was accompanied to the jail by his dog, his cat, and his rat; and he ordered them to go and fetch his gold ring from the Brahmin that night, and to be sure to be back before morning. Away they went at once. The dog swam across the sea, and the cat and rat rode on his back.

"When they arrived at the Brahmin's, they found him asleep under wire musquito curtains. The cat told the rat to gnaw a hole through the curtain, which it did large enough for the cat to get in. They both went in, and the cat said: 'Rat, smell about, and tell me where my master's ring is.' The rat replied: 'I smell the ring in his mouth.' The cat then said: 'I will bite him in the throat, and if he vomits up the ring seize it quickly.' The rat replied: 'Perhaps our master will think we killed the Brahmin, and then he will kill us. To make him throw the ring out of his mouth, I will put my tail up his nostril and tickle him till he sneezes, and then he will throw the ring out of his mouth; and then you must snatch it up immediately.'

"The plan succeeded. They obtained the ring and both ran out of the house to the dog, that was waiting for them outside. He asked, if they had gotten the ring; and on being told they had, he said: 'Give it to me, you cannot carry it safely.' So they gave it to him, and he put it in his mouth.

"The whole three returned then across the sea, as they came; but when half way back, the dog saw a pack of otters in the water and he barked at them, when the ring was thrown out of his mouth into the sea, where it was swallowed by a fish.

"The cat said: 'This is hard. The ring is lost, and our master will be killed in the morning.' The rat said: 'The otters were the cause of this misfortune. Dog, go bite them on the rocks.' The dog leaped on the rocks, and bit an old otter, saying: 'It is on your account that we have lost the gold ring into the sea, and our master will be killed in the morning.' The otter replied: 'Do not kill me, I will get the fish for you.' So he plunged into the water, brought up the fish that had swallowed the ring; and the cat ripped it up and took the ring out of its belly. They then continued their journey, and arrived with the ring without further accident, which they delivered to their master; who then delivered himself from prison, and brought

back the palace with the Brahmin in it. He slew the Brahmin with all his relatives, and exterminated the whole race."

Giants.

Men-eating giants are among the supernatural beings with which a Karen has to contend; and their exploits are heard as often in Karen nursery tales, as they formerly were in Europe. Here is a specimen :

"The elders say that a little girl went down to the brook to draw water in the usual Karen bucket, made of a joint of a large bamboo. When she laid it on the surface of the stream to fill with water, it escaped from her hands, and floated away. She ran after it down the bank, till she reached a dam, which proved to be the dam of a giant. Soon after her arrival, the giant came down to fish, and was about to devour her; but she told her artless tale, and the giant spared her, and took her up to his house. Here they were met by the giantess who congratulated her husband on having picked up so nice a morsel for their dinner. However, the old giant protected the child, and she became their adopted daughter.

"On one occasion, when the old people went out, as they said, to search for greens, they left the little girl in the house, and charged her not to look into two baskets that were in one corner of the room. Her curiosity being excited, no sooner was she left alone, than she peeped into the baskets. One was found filled with gold and silver, and the other with nothing but dead men's skulls.

"Ever after making this discovery, she importuned the giants to allow her to return home; and they finally consented, but the old giantess required before her departure to look over her head once and pick out the vermin; an act of courtesy often performed by Karens for their friends. On looking into her hair, the little girl was astonished to find it filled with green snakes and centipedes. She called for an axe, and chipped away in the head of the old giantess till she could endure it no longer, and then permission was given the little girl to depart.

"Before going, the giants told her she might take one of the baskets with her; whichever one she chose. She said; As you are getting into years, and cannot well weave baskets, I will take the old

one. This she knew contained the gold and silver; and she was permitted to take it.

"When about to start, the giantess said: 'When thou reachest black water, comb thy hair and wipe thy teeth. When thou reachest red water, wipe thy lips; but when thou comest to white water bathe thyself.' She observed the directions given her, and reached home in safety, where the fame of her gold and silver brought together all her friends and relatives; to each of whom she gave a bowl full.

"Among those who received a bowl full of silver and gold, was one dissatisfied young man, who coveted more; so he determined to try his future with the giant, and endeavour to obtain a whole basket full for himself. He succeeded in being adopted into the family, in being allowed to return, and in having the offer of a basket to take with him. He had not looked into the baskets, but like his predecessor he chose the old one. The same charge was given him in regard to crossing the streams, but he paid no attention to his instructions, but dashed across them and got home as quick as possible. On reaching his house, he opened the basket, when to his horror and disappointment, he found the basket full of dead men's skulls. Little time, however, was given him to brood over his misfortunes, for the giant followed rapidly after him, and devoured him on the spot."

Omens.

The Karens, like other nations in their ignorance, believe in omens; and desist from a journey or an undertaking, when they occur. Like the Romans, a snake crossing the path, or a woodpecker tapping, stops a man by the way; as does the falling of a branch of a tree, or the bleating of the barking deer. Sickness is supposed to be the consequence of non-observance, and a sacrifice is offered for an atonement.

Among the Bghais an elder is called, and all the family assembled together: male and female, young and old. The elder then leads a dog round the assembled family three times, praying as he goes: "When we work, or labour; when we go, or return; at the bleat of the barking deer, at the voice of the otter, at the crash of a falling tree, at the sight of a snake, at the sight of a scorpion, at the sight of a large serpent, at the sight of a python, we ought to pause, or

we become sick, we suffer and die. Now we offer thee food to eat, a great dog. Heal this man, let disease leave him."

The dog is then killed, and the elder sits down facing the whole family, with a green bamboo raised two or three feet, and stretched horizontally between them, over which he throws the dead dog, taking it by the legs; and the family catches it and throws it back at him. This ceremony is repeated three times, and then the dog is cooked and eaten.

Soothsaying.

Subjected, as a Karen is, to the multifarious dangers proceeding from the wrath of unseen spirits; he tries, when he has come under the ban of one, and is prostrated by sickness thereby, to ascertain which, it is, that he may propitiate it by suitable offerings.

To make the discovery, he resorts to prophets or necromancers, persons that have eyes to see into the unseen world, and to fowl's bones. Omens too fall within the same category, as giving indications of the future.

Necromancers.

There are persons among the Karens who profess to have eyes to see unseen spirits, to tell what they are doing, and even to go to Hades and converse with the spirits of the dead there. When a person is sick, these people, for a fee, will tell what spirit has produced the sickness, and the necessary offering to conciliate it. They will sometimes go to Hades and bring back the Là that has gone thither, and resuscitate the dead body. This is proven by the following story :—

"The elders relate that there was a woman who had two daughters; and her husband died and left her a widow.

"After their father's death, their mother treated them very cruelly, beating them continually, so that both died and left her alone. Then she grieved, and wept unceasingly, and refused to be comforted. In her distress, she went to a necromancer, and induced him to visit her children in Hades. He found the Là of the youngest, and said to her: 'Thy mother on earth weeps for thee exceedingly. Go comfort her.' The younger then sang to her elder sister.

'Return sister, mother requests,
She weeps for us in deep distress.'

"The elder sister responded:

'Return not to her, sister dear,
'Twas mother beat and sent us here.'

"The elder sister positively refused to return to the earth, but the **Là** of the younger one came back with the necromancer, and on her arrival at home, the body came to life again."

Fowl's Bones.

In the beginning, say the elders, God gave to the Chinese a book of paper, to the Burmese a book of palm leaf, and to the Karens a book of skin. The Chinese and the Burmese studied their books, and taught them to their children; but the Karens were indolent, did not value their book and laid it on the end of their house, where it was thrown down on the ground, and a hog came and tore it up. After the hog had gone, a fowl came and picked up all the fragments.

It soon became apparent even to the Karens that the Chinese and Burmese greatly excelled them in knowledge through their acquaintance with books; and they then regretted the loss of their own book.

They concluded, however, that the fowl which had eaten up the book must possess all the knowledge that the book contained. They resolved therefore to consult its thigh bones, and note the marks and indentations made by the tendons on them as letters, and pray to it to reveal its knowledge.

There is no superstition so commonly practised among the Karens as this. No measure of importance is undertaken, till a favourable response has been obtained from the fowl's bones.

The thigh bones of a chicken are taken out, and after prayer, and making a condition that the bones may exactly correspond, or they may differ in some particular; that the indentations for the tendons, may be alike or unlike, that the bones may be even or uneven; the two bones are held up abreast of each other, between the thumb and finger and carefully examined. It requires a practised eye to read the result accurately, and there are many nice distinctions, known only to the elders, who do not always agree in their readings.

From my house in Karenee, I looked down into the court-yard of the Saubwa, where he was in consultation with some of his chiefs over the chicken bones. They were passed round from hand to hand, each

giving his opinion, and the conclusion reached was, as I afterwards learned, that the omens were favourable for a contemplated attack on a village in eastern Karenee. The fowl, however, deceived them that time; for some half a dozen wounded men of the village were brought in next day, and no plunder.

The Bghais seem to regard the fowl as the bird of Indra, the king of the Deva heavens. Once a year, in February or March, every Bghai family holds a festival, in which every person's wrist is tied with a thread, and prayers are addressed both to the fowl offered, and to Thie-keu, Mo-khie, or Indra. The rite is called: "The good to do;" but of its origin and object, the natives can give no account beyond what is found in the forms themselves. An intelligent Bghai assistant furnishes the following statement:

"When the time approaches, the people prepare beforehand ardent spirits, and buy hogs and fowls, and get every thing ready. When the time actually comes, the villagers perform the ceremony, two or three or four families a day, till it has gone through the whole village.

"The first thing done is to bring up two jars of arrack, and secure them by tying them to a bamboo, and the next is to bring up a hog and fowls. Then an eating dish is washed and filled with water, and set by the side of the jars with spirits.

"An elder is now called on, any one skilled in interpreting fowl's bones, and a fowl is put into his hands. He cuts off the bill of the fowl, dips its head and feet in the water, and then drops the blood from the bleeding head on the forehead of the oldest man of the family that is performing the ceremony.

"The master of ceremonies then addresses the elder, and says: 'The hand-tier devours thee. Thou hast the jaundice, thou art shrivelled up, thou art not strong, thou art weakly. Now we give food and drink to the hand-tier. Mayest thou be strong, mayest thou be vigorous. Mayest thou be established as the rock, indestructible as the hearth stones. Mayest thou have long life, mayest thou have a protracted existence.'"

After besmearing the elder's forehead with the fowl's blood, the master of ceremonies pinches a few feathers and a little down from the fowl's neck, and sticks them on the blood, where they adhere, perhaps for the whole day.

He next addresses the fowl, and says: "Arouse, arouse, Thie-keu's fowl, Mo-khie's fowl, we give thee food, we afford thee sustenance. Thou drinkest in a knowledge of the future, thou eatest superhuman power. In the morning, thou seest the hawk, in the evening thou seest man. The seven heavens, thou ascendest to the top; the seven earths, thou descendest to the bottom. Thou arrivest at Khu-the; thou goest unto Tha-ma [*i. e.* Yu-ma, the judge of the dead]. Thou goest through the crevices of rocks, thou goest through the crevices of precipices. At the opening and shutting of the western gates of rock, thou goest in between; thou goest below the earth where the sun travels. I employ thee, I exhort thee. I make thee a messenger, I make thee an angel. Good, thou revealest; evil, thou revealest. Arouse thee fowl, arouse; reveal what is in thee. Now I exhort thee, I entreat thee, if this man is to live to an old age, if his head is not to be bent down, if he is not to come down crash, like a falling tree, let the right hand bone come uneven, let the bones be short and long. Thou art skilled in the words of the elders, thou knowest the language of old men. The good, thou fully knowest; with the evil thou art perfectly acquainted. Fowl, I exhort thee, I entreat thee; reveal whatever is in thee. And now, if this man's head is to bend down, if he is to come down crash, like a falling tree, if he is to be unable to rest himself from incessant trouble; if unable to overcome obstacles which shall meet him on every hand; if unable to rise up or lie down, if his life is not to be prolonged, if he cannot live, then, fowl, come up unpropitious, come up with the tendon short on the right side, come wrong end foremost. If he be able to obtain sufficient to support life, if he be not overcome by feuds, fowl, come up even. Thie-keu's fowl, Mo-khie's fowl, I pull out thy feathers, I pull at thy skin, I dip thy head, I dip thy feet. Arouse fowl, reveal what is in thee."

Every one in succession is then besmeared on his forehead with the blood of a separate fowl; and then every one marks his own fowl by tying a string to it that he may recognise it after being cooked. Some tie a string on the neck, others on the leg, others on the wing, and others elsewhere. They next scorch off the feathers, and boil them.

The hog is taken if the gall bladder be deemed a good one, otherwise it is rejected. When the rice and meat is cooked, they bring the rice,

and the pork, and the fowls, and the threads, and the bamboo tubes to suck up the drink and the spirits; and all are placed together.

The master of ceremonies then goes and puts two bamboo tubes into the left hand of one, and the gall bladder of the hog and the head of the fowl into his right hand; and then the elder of the family takes the thread and ties his wrist. Each one in succession takes the articles in his or her hands mentioned above, and the elder ties every one's wrist, at the same time praying with each: "Mo-khe, the hand-tier, the good-to-do, we offer thee food and drink, spirits well prepared, a great hog. Defend us; when we go to and fro, look after us. If we fall, raise us up. When we go or return, when we walk on a branch or a beam, when the branches or creepers break down, when we go among the Burmese or other tribes, when we climb trees or descend into the waters, when we go up into the house, or return to the paddy field, may no accident befal us! Stretch forth thy hand, and help us; put forth thy foot and assist us. Go before us, follow behind us. Deliver us from demons, deliver us from ghosts."

After this the person whose wrist is tied, changes the things in his hands from right to left and left to right. Then each one tastes the spirits; after which each one tastes the fowl; and when this is done, an elder is called upon to pray, who prays thus:

"Mo-khe of mountain Kie-ku, Mo-khe of the seven heavens, Mo-khe of the seven earths, assemble together, even the blind, the deaf and the lame; and eat and drink the valuables."

A libation of spirits is then poured out; and after this the drama closes with spirits being served out for all to drink.

ASTRONOMY.

Cosmology.

"There are seven heavens and seven earths." This expression occurs frequently in Karen stories, but the people have no definite ideas on the subject. The sun is supposed to go round the earth. In the west are two massive strata of rocks which are continually opening and shutting. Between these strata the sun descends at sunset, but how the upper stratum is supported, no one can describe.

•In the western ocean is an immense volcanic mountain, which is continually fighting with the water. They have a story which must be of common origin with Sinbad the Sailor.

The Elders say there are fish in the sea as large as mountains, with trees and bamboos growing on them as on land. Voyagers have to be careful where they land to cook. They carry axes, and cut into the ground to try it. If juice springs up where it is cut, they know that they are on a fish; but if the ground seems dry, they are on land, and go to cooking.

It is related that a man landing on an island, went to cooking without trying his ground, and it proved to be a fish which sunk with him into the sea, and then swallowed him. When the man was in the fish's belly, he said to the fish: "When males acquire large game, they shout, and cry out in exultation, but you are silent. Are you not a male? On hearing this, the fish opened his mouth to scream, when the man leaped out and escaped."

The Elders say that when people kill one of these fish, it is impossible for them to eat it all up, and they burn its fat. With its bones they can make beams and rafters for houses.

Constellations.

The Karens have names for a few of the most prominent constellations. The great Bear they call an elephant, and so do the Burmese and Hindus. The pole star is a mouse crawling into the elephant's trunk.

The southern cross they call Mai-la-ka, a name whose derivation is not obvious, but they regard it as some kind of animal; for they say that Mai-la-ka and the elephant once dwelt together in the middle of the heavens, but they quarrelled and fought. Mai-la-ka seized the elephant by his tail, and the elephant took Mai-la-ka by his thigh, and in the struggle which ensued the two were thrown to the opposite extremities of the heavens, where they remain to this day.

The Pleiades is called "the great house," and is regarded as a family of persons, consisting originally of seven persons, but one has been lost, and there are only six now. Two men, one of their myths states, married here two sisters. The names of the men were Lan-to, and To-phau; and of the women Thă-bgheu-mu, and Tha-bgheu-bghai.

While the men were out fishing, "the wife bearer," or Orion, came and carried them off on his shoulder. The women cried out to their husbands:

> "Lau-to, oh, Lau-to dear,
> Snatch up thy bow and spear.
> To-phau, oh, To-phau come,
> We're carried away from home."

After calling a long time, their husbands heard their cries, and returned home, when they discovered that their wives had been carried away. They seized their bows and spears and followed on after "the wife bearer." When they came within a spear's throw of him, Lau-to poised his spear or javelin to throw it at "the wife bearer;" but his younger brother came behind Lau-to unobserved, and struck the handle of the javelin, so that it flew against his father-in-law's house, and knocked a part of it down. To encourage their wives, the men sung:

> "Tha-bgheu-mu, suffering dear,
> Tha-bgheu-bghai, have no fear.
> The bow's bent, the string tight,
> Arrows ready, you in sight."

Then they followed on silently, and "the wife bearer" thinking he was not pursued, stopped and set down his burden to rest; but while he was gone down into the water to bathe, the husbands arrived and carried their wives back home, and repaired their father-in-law's house.

Though the resemblance is remote, yet this story must have had a common origin with the Greek myth of Orion and the daughters of Oenopion.

Some of the Karen constellations, to judge from their names, are of Karen origin. One is called the "Burmese yoke," from the resemblance the stars are supposed to bear to the yoke a Burman carries on his shoulder.

Some names are local and vary in different places. For instance, the Karens in the south call the Milky way the "Paddy Bin;" while the Bghais denominate it the "Bazar street," because the streets in the bazar are usually an undistinguishable mass of people.

COMETS.

Comets are sometimes called "Tailed-Stars," sometimes "Fire-Stars," and sometimes "Smoke-Stars." In common with all other unenlightened nations, the Karens regard their appearance as indicating approaching war, famine, pestilence, or other public calamities.

PLANETS.

The Karens do not seem to recognize any planet, excepting Venus. They know the evening and morning star to be one and the same, and by some process not clearly understood, she is sometimes before, and sometimes after the sun. When a morning star, she is called the "Star receiving the morning;" and when an evening star, the "Star receiving the evening."

SHOOTING STARS.

Shooting Stars are said to be "Youth Stars," going to visit the "Maiden Stars." When a Karen girl sees one she exclaims, "May my hair grow as long as the path thou fliest!"

METEORS.

Meteors, the Karens say, are the animals that produce gold and silver, and when seen in the heavens descending to the earth, are supposed to be returning home. When a report is heard, as the Karens say there often is, it is the roar the animal makes on entering the earth. Wherever they fall, gold or silver is certainly to be found in the neighbourhood.

DIVISION OF THE YEAR.

The Karens divide the year into twelve lunar months, and, like occidental nations, they begin it with January, and end it with December. This is contrary to the usage of all the nations that surround them; the Burmese, the Talaings, and the Shans commencing the year in March. "The civil year," says the Journal of the Asiatic Society of Bengal, "commences differently in different parts of Thibet, varying from December to February. At Asadakh, it begins in December. The months have several names expressive of the seasons, &c., but they are usually denominated numerically; first, second, &c." The Karens would seem then to have derived their calendar from Thibet, for while they make now the year to begin in January, yet

the months corresponding to June and July are designated numerically "the seventh," and "the eighth" months, which must have originated from a system that made December the first month; as our September and October must have been named, when the year was made to commence in March.

The names of many of the months show that they were given when the Karens had the same habits that they have now. Thus January is "the searching month," from the habit of going about in search of a suitable locality to clear a field. And February is "the hewing month," because in this month the trees are cut down. Other names show that the seasons were the same when and where the names were given as they are now. Thus April is "the seed month," because in this month the seed is sown; and August is "the month of gladness," because the corn is then in the ear; like the month of Abib among the Hebrews; but that corresponded to April, indicating a different climate from the Karen. May is "the Crinum" or holy month, because the Crinums, popularly called lilies, are then in flower; while December is denominated "the month of the shades," because in this month the Karens make their annual offerings to the shades of the dead.

The Red Karen names are usually coincident, but a few of the months have different names. July is not with them "the eighth month," though June is the seventh; and August is not "the month of gladness," but is named from a feast that is made this month, and which is peculiar to themselves.

A correspondent writes: "In the month of Ai-du, the Red Karens kill hogs, and fowls, and oxen all at once, and make a feast in which the whole village eat and drink together. They beat drums, and fire off muskets, and have sham fights, firing at each other with nothing but powder in their guns. Accidents often happen, and houses are frequently set on fire. The feast is kept up for three days, and during their feasting the people send food and drink to their friends and relatives in other villages. The origin of the feast is not known."

A CATALOGUE OF DOMESTIC KAREN WORDS, WITH ENGLISH, SGAU, BGHAI, &C. SYNONYMES.

English.	*Sgau.*	*Bghai.*	*Red Karen.*	*Pwo.*	*Taru.*	*Mopgha.*	*Kay or Gaikho.*	*Toungthu.*	*Remarks*
Air	Kalie	Kalie	Kay-lya	Lie		La-lie	Ren-yu	Ta-lie	Siam. *Lon.* Burm. *Lay.*
,, Coup.	Thaughau	Way-thra		Lang		Lay		La	Tal. *La.* Koreng. *Tinghun.*
Ant	Teu	Teu	Teu	Htung		Hten	Hteu	Htung	
Arrow	Pla	Play	Pra	Phla		Pla	Pla	Pla	Koome. *Pala.* Shan *Pen.*
Bird	Hto	Htu-ba	Htu	Hto	Hto	Teu	Htu	Awa	Limbu. *Bu.*
,, Coup.	Lie	Le	La	Lie		Lie			*Lie* signifies a squirrel.
Blood	Thwie	Thwie	Thwie	Thwie		Sweit	Htwie	Thwie	Burm. *Thwe.* Tibet *Thak.*
Boat	Khlie	Khlie	Thau-khlie	Khlie		Hlick	Reu	Phre	Burm. Hlay.
,, Coup.	Hto	Ka-pay	Ta-pay	Htaung		Wa			This couplet signifies a *raft.*
Bone	Ḳhie	Khwie	Kvwie	Khwie		Ḳhie	Hsweit	Hso[illegible]	Shan. *Sot.* Chin. *Kuh,* and *kweh.*
Buffalo	Pana	Pa-nay	Pa-nay	Pa-na	Pa-na	La-na	Pa-na	Pa-na	
Cat	Tha-mie-yau	Mie-yau	Htoo, Htoo-ma-nya	Mein-yau		Mie-zau	May	Nyoo	Chin. *Miau.*
Cow	Klau and Po	Peu	Po, Pu	Klau		Peu	Phouk	Phou	Tibet. *Ba.* *Bos.*
Crow	Sauwakha	So-wa.	Sau-ray	Kla		Sa-gwa	Sa-wa	Zanka	
Day	Nie	Nie	Ne	Nie		Ne	Neu	Ya	Burm. *Ne.*
Dog	Htwie	Htwie	Htwie	Htwie	Shwie	Htwie	Htwie	Htwie	Mru. *Ta-kwie.*

English.	*Sgau.*	*Bghai.*	*Red Karen.*	*Puo.*	*Taru.*	*Mopgha.*	*Kay or Gaikho.*	*Toungthu.*	*Remarks.*
Ear	Na	Nay-koo	Kha-lay, Ne-kyeu-khalay	Na	Na	Na	Ne-ko	Na	Singho. *Na.*
,, Coup.	Nu	Nay-kau	Noung	Nu					
Earth	Hau-kho	La-kheu	Hay-khu	Ghang-kho	Hang-kho	Hau-feu	Hay-khu	Ham-tan	
Elephant	Ka-hsau	Ka-sha	Ta-sha	Ka-hsaung	Hsaung	La-hso	Htsang	Hsan	Shan. *Tsang.* Chin. *Siang.*
Eye	May	Meu-la-doo	May	Me	May	May	Mie	May	Chin. *Moh.* Shan. *Matta.*
Father	Pa	Pa, & Ta	Phay	Pha	Pa	Pa	Pha	Pha	
Fire	Me-oo	Me	Me	Me-ung	Mie	Me-ouk	Me	Me	Botia. *Me.*
Flower	Phau	Phau	Pho	Phang	Phang	Foo	Pho	Heu	Limb. *Phu.*
Foot	Khau	Kha	Kha	Khang	Hang	Khau	Ku-ku	Khan	Tibet. *Kang.*
Goat	May-tay-lay	Pay-ko-lay	Pay	Be		Pie-koo-lay	Phye	Bay	Shan. *Pa.*
Hair	Kho-thoo	Kheu-loo	Kho-lya	Kho-thoo	Khoo-lau	Feu-htook	Kho-louk	Ta-loo	
Hand	Su	Su	Su	Su	Sa	Sook	Sa	Su	Chin. *Syu.*
Head	Kho	Koo-kheu	Hoo-krau	Kho	Khoo	Feu	Ko-kwau	Ka-tu	Burm. *Khoung.* Shan. *Ho.*
Hog	Hto	Htau	Hta	Hto	Hteu	Hto	Htouk	Hto	Chin. Tchee.
Horn	Neu	Neu	Nau	Nong	Nung	Nau	Nu	Nung	
Horse	Ka-the	Thia	Ta-the	Ka-the	Tie	La-gho	Theik	Tha	Botia. *Ta.* Aka. *Ghura.*
House	Hie	He	Hie	Ghaing	Sum	Heik	The	Lam	Shan. *Hien.*
Iron	Hta	Hta-la	Hto-htay	Hta	Hta	Hta-la	Hta-la	Pathie	
Leaf	La	Lay	Lay	La	La	La	La	La	
Light	Ka-pau	Lie	Lie	Phang	Lie	Ta-la-po	Kha		Burm. *Len.* Shan. *Len.*

Man	Pgha-knyau	Pie-ya	Pray-ka-ya	Heu-phlong	Plu	Pei-do,	Pra-ka-yong	Lau	Bu[illegible]
„ Coup.	Pgha-tha-pleu	Pie-yeu		Heu-khong		Ze-zau Plau		Pa-kyoung	Sha *Khoung.*
Monkey	Ta-u	Yeu	Yau	Hseu-oo		Ze	Yau		There is no generic term for monkey
	Ka-yu-pha	Yeu-ka-phay	Yau-ku	Ka-yeu-pha		Zeu-la-po			
	Ta-thwa	Ka-nie	Ta-nie	Hieu-awa-me		La-nie	Myeu		
Moon	La	Lay	Lay	La	La	La	La	La	Shan. *Leu.*
Mother	Mo	Meu	Meu	Mo	Mo	Am	Mu, A-yeu	Meu	Shan. *Amya.*
Mountain	Ka-se	Khau mu	Sho	Kho-laung	Khaung	La-seu	Khwau	Koung	Chin. *Khou.*
„ Coup.	Ka-lo	Khau-lau	Lya	Htoung-lo		La-lau			Siam. *Kham-ta.*
Month	Hta-k	La-mau	Kha-oo	No	Guwa-kho	Hta-feu	Kha	Proun[illegible]	
Musquito	Pa-so	Pa-so	Phu-shie	Pa-so		La-seu	Ka-poo-ta-yo	Ta-khi	
Name	Mie	Mie	Mie	Meing	Myoung	Em, Meik	Mie	Meing	Bhotia *Ming.*
„ Coup.	Tha	Thay	Thay	Tha		Ta			Chin. „
Night	Na	Nay	Nay	Na		Na	Na		
Evening	Ha	Hay	Hay	Gha	Ha	Ha	Ha	Ha	
Oil	Tho	Theu	Thoo, Htya	Tho		Nay-teu	Beu	Na-ma	
Plantain	Tha-kwie	Ya	Die-kl	Tha-kwie	Gna	La-kwie	Kwie	Gna	Shan. *Hwa.*
„ Wild	Ya	„		Ya		Za			Burm. Gna-pyau.
River	Lo, Klo	Lau	Klo	Lo		Loo	Lau		
Road	Klay	Klay-poo-tha	Klya	Pung-tha		Peu-ta	Klay	Klay-t	
Salt(no[illegible]	tha	Ie-thay	Ie-thay, [illegible]r Te-thay	Htie-la		Deik-ta	Se-[illegible]hay	Ta-tha	

English.	*Sgau.*	*Bghai.*	*Red Karen.*	*Pwo.*	*Taru.*	*Mopgha.*	*Kay or Gaikho.*	*Toungthu.*	*Remarks.*
,, (verb)	Hau	Hay	Hay	Ghang		Hau	Heing		
Skin	Phie	Phe	Phie	Phe		Pa-hie	Phie	Phro	Chin. *Pi.*
Sky	Moo-ka-po-lo	Mau-ka-pau-la	Mau-kla-me-lo	Moo-po-long		Mau-hyo-apho-pho	Sa-keu-tha		There is no single word for *sky* in Karen.
Snake	Ghu	Woo	Roo	Ghoo	Roo	Ghuk	Roo	Hru	
Star	Hsa	Shay	Shay	Sha	Hsa	Hsa	Hsa	Hsa	Chin. *Sing*
Stone	Leu	Leu	Lau	Long	Lung	Louk	Louk	Lung	Lepcha. *Long.* Limbu *Lung.*
Sun	Mu	Mu	Lă-moo	Mu	Myung	Meu	Myeu	Mu	
Tiger	Khe, or Bo-tha-o	Khe, or Tay-poo-lie	Khie	Khe		Ta-pa-leik	Khe	Ka	Burm. *Kya.*
Tooth	May	Theu-may	Kho-khe	May	Me	Swa-hteik	Tha-khe	Ta-gua	Burm. *Thwa.*
Tree	The	Theu	Thau	Theing	Teing	Te	Theu The		
Village	Thă-wau	Deu	Dan	Tă-wang		Deu	Hay-khu		
Water	Htie	Htie	Htye	Htie	Hseu	Hteik	Sheu	Htie	Chin. *Shui.*
,, Coup.	No	Kă-nau		Noung					Siam. *Nam.*
Yam	Nway	Nway	Kreu	Nway	Nwe	Nway	Nway	Nwa	

The following table exhibits the pronouns in all their forms, in the various dialects.

	Case Absolute. I, as to me.	*Nominative. I.*	*Objective. me.*	*Poss. Pron. my.*
Sgau	Yá, or yay	Ya, yeu seu	Yá or yáy	As nominative.
Pwo	Yeu, or yawe	Ya, or yeu	Yeu	,,
Bghai	Yay	Ya	Yay	,,
Mopgha	Zá	Za	Zá	Ei
Toungthu		Khwa		
Red Karen		Va		As nominative.
Kay or Gai-kho		Khye	Khye	
Taru		Ya		

	Thou, as to thee.	*Thou.*	*Thee.*	*Thy.*
Sgau	Ná, or nay	Na, or neu	Ná	As nominative.
Pwo	Neu, or nawe	Na, or neu	Neu	,,
Bghai	Nay	Na	Nay	,,
Mopgha	Ná	Na	Ná	,,
Toungthu	Ná	Na	Ná	
Red Karen		Na		,,
Kay, or Gai-kho		Na		,,
Taru		Na		

	As regards &c.	*He, she, it, they.*	*Him, her, it, them.*	*His, her, its, their.*
Sgau	Away	A, or way	Au	A.
Pwo	Awe	A, or we	Eu	A.
Bghai		Seu	Say	A, or Sa
Mopgha		O, or wo		
Toungthu		Wa		
Red Karen		A		,,
Kay, or Gai-kho		Hwon		,,
Taru		A		

	Case Absolute. We, as regards us.	*Nominative We.*	*Objective. Us.*	*Poss. Pron. Our.*
Sgau	Pa way	Pa, or peu	Pgha	As, Nomin.
Pwo	Pa we	Pa, or peu	Peu	,,
Bghai	Kay	Ka, or wa	Kay	,,
Mopgha	Kay	Ka	Wau	Oo, or Ei.
Toungthu		Ne		
Red Karen		Pay		As nominative.
Kay, or Gaikho		Pa, or ka		,,
Taru		Pa		

	You, as regards you.	*You.*	*You.*	*Your.*
Sgau	Thu way	Thu	Thu	As, Nomin.
Pwo	Nathie	Nathie	Nathie	,,
Bghai	Thie	Thie	Thie	,,
Mopgha	Nay	Nay	Nay	,,
Toungthu	Nathie	Nathie	Nathie	
Red Karen		Thie		,,
Kay, or Gaikho		Thu		,,
Taru				

English.	Sgau.	Byhai.	Red Karen.	Red Karen. 2nd Form.	Pwo.	Taru.	Mopgha.	Kay, or Gaikho.	Toungthu.	Remarks.	
One	Ta	Ta	Ta	Ta	La	Mau	La	Ta	Ta	Tal. *mu-a*	
Two	Khie	Kie	Ne	Tho	Nie	Neu	Schheu	Neu	Nie	Shan. *htsoung*	
Three	Theu	Theu, or teu	Theu	Tha	Thung	Tu	Teu	Theu	Thung	Tibet. *sum*	
Four	Lwie	Lwie	Lwie	Ta-to	Lie	Lwie	Lwie	Lwie	Leet	Limbu. *lish*	
Five	Yay	Yay	Nya	Ha	Yay	Gnay	Zay	Gnei	Gnat	Bur. *gna*	Shan. *ha.*
Six	Khu	Theutho	Theutho	Ho	Khoo	Hso	Khu	Sho	Thu		,, *hok.*
Seven	Nwie	Theutho-ta	Theutho-ta	Se	Nwe	Nway	Um	Nway	Nwot	Limbu. *nush*	,, *tset.*
Eight	Kho	Lwietho	Lwietho	Ta-pya	Kho	Hsoo	Kho	Shau	That	Lepcha *kakeu*	,, *pet.*
Nine	Khwie	Lwietho-ta	Lwietho-ta	Kau	Khwie	Kwie	Khwie	Kway	Koot	Shan. *kowt, kau*	
Ten	Tahsie	Tashie	Tashe	Ta-kha	Lahsie	Hseu	Lashie	Ta-sheu	Tasie	Chin. *shi.* The first root is *one.*	
Eleven	Tahsieta	Tashieta	Tasheta	Ta-kha-ta	Lahsiela			Ta-sheu-ta	Tasieta		
Twenty	Khiehsie	Kieshie	Neshe	Gna-to	Niehsie		Schheu-shie	Neu-sheu	Niesie		
Hundred	Takaya	Takayay	Tayay	Ta-yay	Laya	Aya	Laza	Ta-ya	Talyea		
Thousand	Takahto	Takahtau	Tarie	Ta-rie	Lahtaung	Alie	Lahto	Ta-htau			
Twelve	Ta-hsie-kie	Ta-shie-khie	Ta-shi-nie	Ta-kha-nie	La-hoie-nie	Shie-schheu		Sheu-neu			
Thirty	Theu-hsie	Theu-shie	Theu-shie	Tha-kha	Thung-hsie	Tu-shie		Theu-sheu			
Forty	Lwie-hsie	Lwie-shie	Lwie-shie	Thie-kha	Lie-hsie	Ouie-shie		Lwie-sheu			
Fifty	Yay-hsie	Yay-shie	Nya-shie	Ha-kha	Yay-hsie	Gnay-shie		Guei-sheu			

English.	Sgau.	Bghai.	Red Karen.	Pwo.	Taru.	Mopgha.	Kay or Gaikho.	Toungthu.	Remarks.
Of	A	A	A	A		A	A		
From	Leu	Dau, Leu	Deu	Leu Day Ta		Leu	Dwa		
To	Hsoo	Seu	Seu	Shaing		Seu	Hsa, Dwa		
By	Leu, Dau	Lay	Rau	Leu Day		Leu	Deu		
With	Dau	Lay	Rau	Day		Leu	Dwa, Deu		
Without									No proper word in Karen. Expressed by an idiom.
In	Poo	Poo	Koo	Phung		Poo	Koo		
On	Phau-kho	Dau-kheu	Klau-khoo	Phang-kho		Dau-fō	Deu-kheu		
Now	Khay-kă-neie	Khau-neu-yeu	Kho-nya-ae	Bong-na-ing-yo		Khau-nay-ie	Kha-yo		
Then	Tu-nu-ta-blau	Ta-nu-ta-pla	Tyeu-nyeu-ta-pgheu Tyeu	Htaung-nau-la-blang		Htau-nu-la-plau Tu, Ftau	Tu-nu-ta-blay		
When	Tu	Teu	A-khay-byie-te	Htaung		A-kha-play-lay	Tu		
When ?	A-kha-phay-day	A-khay-be-day		A-khay-htaung-lag			Deu-ma		
To-day	Ma-htta-tanie	Ma-shay-ta-nyie	A-ae-ta-nyie	Mu-hta-ta-nie		Ma-la-nie-ie	Mu-htsata-neu		

To-morrow	Khay-ghau-ta-nie	Kau-moo-hau-ta-nie	Shie-pu-ro-ta-nyie	Kay-mu-ghau-ko	Ko-ma-gho	Hay-so-a-vo
Yesterday	Mā-ha-ta-nie	Moo-hay-ta-nie	Ma-shay-ta nyie	Mu-gha-la-nie	La ma-ha-nie	Ma-ha-ta-neu
Here	Phay-ie	Be-yeu, Dau-yeu	Byie-ae	Htaung-yo	Play-ie	Be-yo, Be-yeu Dwa-yeu E-yo
There	Pay-ne	Be-neu Dau-neu	Byie-nyeu	Htaung-nau	Play-nu	Deu-gna
Where?	Pay-lay	Dau-lay	Byie-te	Htaung-lay	Play-lay	Ba-ma, Deu-ma
Above	Phau-kho	Dau-kheu	Klau-khoo	Phang-kho	Dau-fō	Deu-kheu
Below	Phau-la	Kau-lay	Klau-lay	Phang-la	Fo-la	La
Between	Beu-hseu	Deu-seu	Sau-koo	Bong-hseung	Bau-hseu	Deu-htseu
Without	Leu-kho	Leu-khau-kheu	Klau	Leu-khaung	Leu-khau-fō	Deu khau
Within	Leu-ă-poo	Leu-ă-poo	Koo	Leu-a-phung	Leu-a-poo	Deu-koo
Far	Yie	Ye	Ye	Yaing	Yie	Yeu
Near	Boo	Bo	Phoo	Boo	Beu	Phu
Little	Hsie	Shie	Pa-bie-ta-ke	Pay	Shie	Shie
Much	A	Ay	Ay	A	Pge	A
How much	Hsie-à-lay	Pghe-lay	Bà-te	Hsie-à-lay	Pge-le	Bghe-ma
Thus	Yau-ie, Die-ie	Ya-yeu	Pho-ae Pho-nyeu	Bay-yo Bo-yo	Zie ie	Ka-yeu
How?	Yau-lay, Die-lay	Ya-lay	Pho-te	Bay-the-lay Bo-lay	Zie	Ka-ma

English	*Sgau*	*Bghai.*	*Red Karen*	*Ta.*	*Mopgha.*	*Kay or Gaikho.*	*Taungthu.*	*Remarks.*
Why?	Bà-mă-nu-lay	Bay-ma-nau	Bay-tie-te	Bay-ıau-lay	Bä-ma-nei	Ba-ta-ra		
Yes	Eu, Me-yeu	Eu, Me-ba	Eu, Ma-hau	Eung May-youk Mway-youk	Su Me-bo Me-no	Eu Mwe-ra		
No, no	Tă-me-bà, Me-ĕ	Nau, Tă-me-nau	To, Ma-to	May-e Mway-e	Me-ay	Seu-mwe-koo		
And, a	Dau	Lag	Vau	Day	Dyo	D va, Deu Lay		Burm. *Le.*
Or								here is no word for *or* in Karen. It is expressed by an idiom. *
That	A-ne	A-neu	A-nyen-ta-pray	A-nau	A-nu	Deu-gna		
Which	Phay-lay-gha-lay	Dau-lay-ta-pghay-nau	Byie-te pray-tı	La-gha-gha-lay	Htaing-lei la-gha-lei	Deu-ma-ta koo-koo		
Who?	Ma-tà-tă-gha-lay	Me-pgha-nauta-pghay-nau		Phau-la-gha-lay	Me-pa-lei-la-gha-lei	Me-pa-pra-ta-pra-pra		
Eat	Au	E	E	Ang	Au	Ay		
Drink	Au	Au	O	Au	Oo	Hwō,	Awa	
Sleep	Mie	Shau-mie	Mye	Mie Mi	Meik	Mie	Ping	
Wake	Phu .he-	Phoo-thie-nay		Nang-a-tha	Phu-se-	Khyau-htaung	Ting	

Smoke	Au-mo	Au	O-mye	Au-mo		Oo-	Hwo-	Awa-	*Lit.* Drink [illegible]ga or pipe.
Laugh	Nie	Dje	Nvie	Nie	Gna	Ne	Nga	Nga	
Weep	Hau	Ha	Gneu	Ghang		Ho	Nga		Burm. Ngo.
Be silent	Bghau	Sau		Lang-mang		Sau	Nie-soo		
Speak	Kă-to, Po	Apo, hie, vie,	He-bay	Khlaing	Tung-shwi	Po	Bā-swie	Nging	Burm. *Ngyein.*
Come	Hay	Le	Ray, Ha	Ghay		Hay	Le	Lon	Come and go some of the dialects are distinguished only indirectly.
Go	Lay	Le	Syeu	Le	Lay	Le	Le	Lway	Sunawar. *Lau.*
Stand up	Hseu-hteu	Shauh-teu	Se-htau	Hseun-tung		Sheu-hteu	'Thau-hteu	Ung-htung	
Sit down	Hse-nau	Sha-na	O-nya	Hse-naug		Hsau-	Ie-nang	Ung-lau	
Move	Thu	Theu	Thau	Thu		Thu	Thu		
Walk	Ha	Hay	Hya	Gha. Saing		Ha	Hsa	Lay	Burm. *Lay.*
Run	Sie	Sway	Kywa	Saing-ta-laing		Sie	Swa	Lau	Chin. Tsou.
Give	He	Ie	Dye	Pe	Pe	He	Pe	Pha	Shan. *Pau.* Burm. *Pay.* Saus. *da.*
Take	Hie-ne	Bie-ne	Phie-ne	Phoung-pie		Siez	Pie-ne	Khou	
Strike	Tau	Peu	Mu	Do	Van	Peu	Htei	Tway	Shan. *Pautihu.*
Kill	Ma-thie	May-thie	Me-thye	Ma-thie	Ma-thie	Ma-teik	Ma-thu	Ma-thie	Chin. *Ta.* Literally *make death.*
Bring	Hay-sau	La-sa	Sau-ray	Gray-hso		Le-so	Mu-yeu		Bring and take away are made from the same root.
Take away	Ke-sau	Ke-sa	Syu-ku	Htaing-hso		Le-so	Seu-yeu		

English.	*Sgau.*	*Bghai.*	*Red Karen.*	*Pwo.*	*Taru.*	*Mopgha.*	*Kay or Gaikho.*	*Toungthu.*	*Remarks.*
Lift up	Sau-htau	Sa-hta	Htyeu-htya	Hsa-h ang		So-tau	Pau-htang	Hya	Literally, *carry-ascending.*
Hear	Na-hoo	Shau-nay	Ne-hyeu	Na-he ing	Na-ko	Na-hoo	Ne-hu	Heun	
Understand	Na-peu	Nay-koo-nu	Nyeu-kha-lay-koo	Na-th		A-nam	Na-theing	Thena	
Tale	Sie-ba	Dau-bey	Dya-sho, Hie-bay	Lau-ba		Po-ba	Sie-ba	Thou-thau	
Good	Ghe	We	Rea	Ghe	Rie	Ghie	Rie		
Bad	Eu	Kie-kay	Hea-kay	Eung		Eu	Kie-ka	Kay	Greek. *Ka-kia.*
Cold	Gho	Wau	Ro	Ghaung		Ghau	Rau	Khwa	Shan. *Kat.*
Hot	Ko	Keu	Koo	Kho	Ko	Ko	Koo		
Raw	Thie-kă-say	Thie-the	Thye-thyeu	Theing-h e		Wook	Tha-thung		Shan. *Leu.*
Ripe	Mae	Mei	Mye	Meing	Mie	Meik	Mie	Hma	Burm. *Hme.*
Sweet	Hseu	Shie	Shyu	Hseung		Seu	Hseu	Neu	
Sour	Hsie	She	Shye	Hsaing	Hseik	Shie	Sheu	Hsya	Shan. *Hts.*
Bitter	Kha	Khay	Khay	Kha	Kha	Kha	Kha		Burm. *Kha.* Shan. *Khou.*
Handsome			To			La-la-pau	Phu-sa-na		
Ugly			To-to						Negative of handsome.
Straight	Lo	Na	Sau	Loung	Na	Lo	Seu	Sou	
Crooked	Ke	Ke	Ka	Kaing	Ka	Kay	Ke	Nga-keu	
Black	Thoo	Lay, Thie-che	Thyeu, Lau Thyie	Theur	Tyeung	Tu	Su	Phren	Shan. *Laing.*
White	Wa	Bo-tha	Boo	Wa	Phoo	Gwa	Bo	Bwa	
Red	Ghau	Lie	Lie	Wau	Lie	Wook	Hlie	Tanya	Shan. *Laing.*
Green	He	Thă-klo	Klo, Thyeu	Yay		Klo	Ka-louk		
Long	Htau	Hta	Htoo	Htau	Htau	Htoo	Htu	Hto	
Short	Phu	Pheu	Phu	Pie	Phu	Pheu	Phu	Pu	
Tall									Same as *Long.*

On the Pendulum operations about to be undertaken by the Great Trigonometrical Survey of India; with a sketch of the theory of their application to the determination of the earth's figure, and an account of some of the principal observations hitherto made.—*By Capt.* J. P. Basevi, *R. E., 1st Assistant, Great Trigonometrical Survey of India.*

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Whilst Lieut.-Colonel Walker, R. E., the Superintendent of the Trigonometrical Survey, was in England last year, General Sabine, the President of the Royal Society, solicited his attention to the importance of making a series of Pendulum observations at the stations of the Great Indian arc, of a similar nature to those made by Captain Kater at the stations of the English arc, and by himself, Captain Henry Foster and others in various parts of both the Northern and Southern hemispheres. Pendulum observations were made on the French arc by Arago, Biot and Mathieu early in this century; it is also the intention of the Russian Government to have them made at the principal stations of the Russian arc: moreover there is hardly an instance of the measure of an arc which has not been accompanied by such observations.

General Sabine offered to assist by placing at the disposal of the India Board the pendulums, clocks, and apparatus which he had employed in his own operations; and he added that, should the India Board desire any opinion from the Royal Society on the subject, he would assemble a Committee for the purpose.

Colonel Walker drew up a scheme and estimate of the probable expense, and submitted it with General Sabine's letter for the approval of the Secretary of State for India, who, acting on General Sabine's suggestion, requested the Royal Society to report on the plan of operations proposed by Colonel Walker.

The President accordingly called for opinions from several distinguished Fellows, viz. Professors Challis, W. H. Miller, Stokes, H. J. S. Smith, Dr. Robinson, Sir G. Everest, and Sir John Herschel; all in their replies were agreed on the scientific value of the operations, and

all, with the exception of Sir George Everest,* approved of the proposed plan of carrying them out; several made very valuable suggestions.

The Secretary of State in Council consequently sanctioned the experiments, and on Colonel Walker's recommendations he directed Captain Basevi, R. E., who was then in England on furlough, to proceed to Kew to learn the use of the Pendulum and apparatus, with the view of his conducting the experiments in India.

Before detailing the proposed operations, a sketch of the theory, and of what has hitherto been done in the way of Pendulum experiments, may be interesting. The application of Pendulum experiments to determine the figure of the earth, is based upon a theorem demonstrated by Clairaut, which may be stated thus, that the sum of the ellipticity† of the earth, and the fraction expressing the ratio of the increase of gravity to the equatorial gravity is a constant quantity, and is equal to $\frac{5}{2}$ of the ratio of the centrifugal force to the force of gravity at the equator. Hence by ascertaining the difference between the polar and equatorial gravity, or, which is the same thing, the progressive increase in the force of gravity in going from the equator towards the pole, the ellipticity of the earth is at once determined.

It is proved in mechanics that the forces of gravity, at any two stations on the earth's surface, are proportional to the lengths of the seconds Pendulum at those stations, or to the squares of the number of vibrations made by the same pendulum in any given time, one solar day for instance. Here is at once an easy means of determining the variations in the force of gravity, and the solution of the problem of the earth's ellipticity is reduced to the measure of the length of the seconds pendulum at a number of points on the earth's surface, or, as has been most generally done, to the observation of the number of oscillations made by the same pendulum in a mean solar day.

This theory, however, supposes the pendulum to be a "simple pendulum" that is, to consist of a material point suspended by a string without weight, which is, of course a practical impossibility; but as

* Sir G. Everest proposed to employ only the Pendulum of an astronomical clock, but this method is objectionable, as the Pendulum cannot be said to be acted on solely by gravity.

† The ellipticity or compression, as it is sometimes called, is the fraction whose numerator is the difference between the polar and equatorial semi-diameters, and the denominator is the equatorial semi-diameter.

it is always possible to calculate the length of the simple pendulum which would vibrate in the same time as a given compound pendulum, the latter may be used for precisely the same purposes as the former.

Besides this, there are several other conditions supposed to hold good, which in practice are never attained, viz. the arc of vibration has been assumed to be indefinitely small, the length of pendulum to be constant, *i. e.* unaffected by temperature, and the oscillations made in vacuo and at the level of the sea. Corrections have therefore to be computed and applied to the observations, for each of these assumptions.

The time of vibration* in a circular arc is expressed in terms of the length of the pendulum, the force of gravity, and a series of ascending powers of the arc of vibration. The arc is always small, but still not so small that the terms depending on it can be wholly neglected; the first term, however, of the series is all that is ever appreciable in practice. Again, the observations are generally continued for a considerable time, and the change in the arc of vibration has to be taken into account. It has been shewn mathematically, on a certain supposition regarding the resistance of the air, and found to be the case practically, that the arc decreases in a geometric ratio, whilst the times increase in an arithmetic ratio, and on this principle the correction† to the observed time of oscillation is computed.

Secondly, a correction must be applied for the temperature of the pendulum: a change of temperature will, of course, by altering the length of the pendulum, affect the time of its vibration. This cor-

$$* \; t = \pi \sqrt{\frac{l}{g}} \left\{ 1 + \left(\frac{1}{2}\right)^2 \mathrm{Sin}^2 \frac{\alpha}{2} + \left(\frac{1.3}{2.4}\right)^2 \left(\mathrm{Sin}^2 \frac{\alpha}{2}\right)^2 + \ldots \right.$$
$$\left. \ldots \left(\frac{1.3.5.\,..\,(2n-1)}{2.4.6.\,\ldots\,2n}\right)^2 \left(\mathrm{Sin}^2 \frac{\alpha}{2}\right)^n \right\}$$

in which t = time of one oscillation.
π = semi-circumference of a circle whose radius is unity.
l = length of the Pendulum.
g = force of gravity.
α = arc of semi-vibration.

† The formula for this correction is

$$n.\frac{\mathrm{M.}}{32} \; \frac{\mathrm{Sin}\,(A + a)\,\mathrm{Sin}\,(A - a)}{\mathrm{Log\,Sin}\,A - \mathrm{Log\,Sin}\,a} \text{ in which}$$

n = number of oscillations made in a day; M = log *i. e.* modulus = 0·4342945; A the *initial* and a the final semi-arcs of vibration. Correction always additive.

rection* must be determined experimentally. Captain Kater immersed his pendulum in fluids of different temperatures, and measured with a micrometric arrangement the alterations in its length. Captain (now General) Sabine observed the change in the number of vibrations made by a pendulum in different temperatures. This is the most direct method of obtaining the correction undoubtedly, but everything depends on the perfect compensation of the clock pendulum with which it is compared.

Thirdly, the formula is only true for observations in a vacuum, and as observations have generally been made in air, or at all events only in a partial vacuum, the effect of the air has to be taken into account. This effect is to diminish the weight of the pendulum by the weight of the air displaced, or to diminish the apparent force of gravity in the same proportion. In the very large majority of observations, the correction has been computed on this consideration solely; but Bessel demonstrated in 1828† that this correction was insufficient, inasmuch as a portion of the surrounding air was set in motion by, and moved with, the pendulum so as to become part of the moving mass. The correction for this can only be determined practically, as by swinging the pendulum in "media" of different densities. It depends chiefly on the form of the pendulum. As this correction "reduction to a vacuum" or "buoyancy correction" as it is

* According to Kater's method—if τ be the standard temperature which is generally taken as 62° Fahrenheit; t the observed temperature of the pendulum: f its factor of expansion for 1° Fahrenheit, then correction $= \frac{1}{2}\ n.\ f.\ (t-\tau)$. positive when $t > \tau$.

† This circumstance was most clearly pointed out by the Chevalier du Buat in 1786, who made a number of experiments with pendulums formed of different substances, but his researches, which created a great sensation at the time, appear to have been completely lost sight of, and to have been unknown even to Borda, who was conducting his experiments, little more than ten years after the publication of Du Buat's results.

The *true* correction for buoyancy Mr. Baily has shown to be (Phil. Trans. 1832)

$C \times \dfrac{\beta}{1 + .0023\ (t-32^\circ)}$ where β, is the height of Barometer, and t, the temperature during the interval of observation. C is a *constant* for the *same pendulum*, and is determined from the formula

$C = \dfrac{N''-N'}{\beta'-\beta''}\ [1 + .0023\ (t^\circ-32^\circ)]$ in which N' is the number of vibrations in a mean solar day, β' and t' the barometer and thermometer readings, *in air;* and N'' β'' t'' the same quantities in a *highly rarified medium,* $t^\circ = \frac{1}{2}\ (t' \times t''$.)

called, depends also on the state of the atmosphere, it is necessary for its calculation, to record the readings of the barometer, when the observations are taken in air.

The last correction is for the height of the station of observation above the mean sea level. The force of gravity varying inversely as the square of the distance from the earth's centre, a pendulum swung at a certain elevation above the sea, will make fewer oscillations in a day than at the level of the sea, and a correction has to be added on this account. Dr. Young, however, demonstrated that the correction computed on this consideration alone, was too large, as it neglected the attraction of the elevated mass itself, and he showed how this might be approximately allowed for.*

The general principle followed in determining the length of the seconds pendulum, is to observe the number of vibrations made by a pendulum of known length, in a mean solar day; then the length of the seconds pendulum is found by multiplying the length of the given pendulum, by the square of the number of its vibrations in a day, and dividing by the square of the number of seconds in a day.

The number of vibrations is generally determined by the method of coincidences. The detached pendulum is placed in front of a good clock, and adjusted to such a length as to gain or lose, (the latter generally) two beats upon the clock in some convenient time, 5 to 10 minutes. Suppose the pendulums to be started together, then the longer one of the two will be left behind by the other, the distance between them continually increasing, until at length they will be at opposite extremities of their arcs of vibration at the same moment: the longer pendulum has now lost one oscillation on the shorter one, and both are apparently going at the same rate, but in opposite directions; after a short time they will begin to approach each other, the distance between them gradually diminishing, until they both appear to coincide. It is clear that between two consecutive coincidences the

* This correction is given by the formula $\frac{n}{r}\, h\, x$, where n denotes the number of oscillations in a mean solar day, r the radius of the earth at the given station, h the height of the station above the mean level of the sea: x is an unknown quantity determinable from theory; on the assumption that the mean density of the earth is 5.5 and that of the surface 2.5 Dr. Young (Phil. Transactions 1819) showed that the correction for a station on a tract of *table* land would be reduced by $\frac{1}{3}$rd or that the correction $= \frac{2}{3}\, n\, h$.

off on them a scale, transferred from Colonel Lambtons's scale; the length was then measured by a pair of beam compasses. The length of the seconds pendulum was found to be 39.0263 inches of this scale *in air.*

In 1818, Captain Kater published his determination of the length of the seconds pendulum in London at Mr. Browne's house, Portland Place, taken for the purpose of fixing the standard of English measures. His method was founded on the dynamical theorem due to Huyghens, that the centre of oscillation, and axis of suspension, are reciprocal in the same body; that is, if the body be suspended at its centre of oscillation, the former axis of suspension will pass through the new centre of oscillation, and the body will vibrate in the same time as before. The distance from the axis of suspension to the point called centre of oscillation, is equal to the length of the simple pendulum.

In 1822, the English Government sent out an expedition under Captain, now General, Sabine, for the purpose of extending the enquiry commenced by Captain Kater; for both Kater and Biot had come to the conclusion, from a discussion of their experiments, that no decisive result of the earth's ellipticity could be obtained from them, on account of the smallness of the comprised arc, and the variations of local density. Captain Sabine visited thirteen stations between Bahia, S. Lat. 12° 59′ to Spitzbergen N. Lat. 79° 50′. He had with him three pendulums of Kater's invariable pattern, which were all swung at each station. Besides these he had the two clocks and attached pendulums which he had already used on his arctic voyages. His method of observation was similar to Captain Kater's; all the pendulums were swung in London at Mr. Brown's house, both before and after the expedition.

Captain Sabine subsequently determined the difference in the number of vibrations made by an invariable pendulum between London and Paris, London and Greenwich, and London and Attona. He also determined the true buoyancy correction for Kater's convertible pendulum.

In 1825 M. Bessel made his experiments for determining the length of the seconds pendulum at Konigsberg, with an apparatus constructed and partly designed by Repsold the celebrated artist of Hamburg

The apparatus was contrived so as to avoid any uncertainty in the centre of oscillation of the pendulum, as well as any error in the measure of its length, by observing the times of vibration of a pendulum ball suspended alternately by two wires, whose difference in length was known.

A toise was set upright on a narrow horizontal plane firmly fixed to a perpendicular iron bar, and the contrivance by which the pendulums were suspended could be placed either on the horizontal plane, or on the top of the toise itself, so that the effective lengths of the wires differed in the two cases by an amount exactly equal to the length of the toise. The wires, which were of steel, were attached to a thin strip of brass which unwound itself over a small cylinder. The pendulum, thus suspended, described the curve called the evolute of the circle. At the lower end of the iron bar, there was a micrometer screw for measuring small differences in the height of the ball.

The system of observation was as follows. At the commencement of a series of coincidences with the longer pendulum, the thermometers attached to the toise were recorded, and the reading of the lower surface of the ball was taken with the micrometer screw; the pendulum was then set in motion, and after a sufficient number of coincidences had been observed, the readings of the ball and thermometers were again taken. Exactly the same process was then gone through with the shorter pendulum: then from the times of vibration of the two pendulums, whose absolute lengths were unknown, but whose difference in length was accurately known, the length of the seconds pendulum was easily computed.* There were a great many minute details to be attended to, all of which were carried out with the greatest ingenuity

* Let t_1 & l_1 be times of vibration and length of longer pendulum.
t_2 l_2 " " " shorter "
$l_1 - l_2$ = difference in length $= a$
L = length of seconds' pendulum.

Then $t_1^2 = \eta^2 \frac{l_1}{g}$, $t_2^2 = \eta^2 \frac{l_2}{g}$, $1 = \eta^2 \frac{L}{g}$

$$\therefore \frac{t_1^2}{t_2^2} = \frac{l_1}{l_2}, \quad \frac{t_1^2 - t_2^2}{t_1^2} = \frac{l_1 - l_2}{l_1} \text{ or } \frac{l_1}{t_1^2} = \frac{}{t_1^2 - t_2^2}$$

$$\text{Again } \frac{1}{t_1^2} = \frac{L}{l_1} \text{ or } L = \frac{l_1}{t_1^2} = \frac{a}{t_1^2 - t_2^2}$$

and nicety, and all conceivable sources of error were considered and their effects computed and allowed for.

The coincidences were observed in a slightly different way from any preceding method. The pendulum was enclosed in a wooden case, faced with glass to keep out currents of air, as well as to preserve as constant a temperature as possible; the clock was placed about $8\frac{1}{2}$ feet in front of the pendulum, and between the two, the object glass of a telescope was adjusted to form an image of the detached pendulum in the plane of the clock pendulum, to enable them both to be seen simultaneously through the observing telescope, which was set up at a distance of about 15 feet. On the wire of the detached pendulum was fixed a small brass cylinder, painted black and called the coincidence cylinder; it weighed something under 4 grains, and could be brought exactly opposite the scale for measuring the arc of vibration.

Captain Kater's pendulum consisted of a bar of plate brass 1.6 inches broad and $\frac{1}{8}$th of an inch thick: two knife edges of the hardest steel, attached to solid pieces of brass, were fixed to the bar at a distance of rather more than 39 inches from each other; when the pendulum was in use, these knife edges rested on horizontal planes of agate. At one end of the bar, immediately below the knife edge, was a large flat brass bob firmly soldered to it; and on the bar, between the knife edges, were two sliding weights. The plan of operations was to observe the number of vibrations per diem, made by the pendulum when suspended, first, by one knife edge, and then, by the other; and if these numbers were not identical, to make them so, by means of the sliding weights. The distance between the knife edges, that is, the length of the corresponding simple pendulum, was then measured by a micrometric arrangement. The method of observing the number of vibrations was as follows; to each extremity of the pendulum, a light deal tail-piece, well blackened, was attached; and on the bob of the clock pendulum a white paper disc, equal in diameter to the breadth of the tail-piece, was fastened; the detached pendulum was now placed in front of the clock, and both pendulums being at rest, a telescope was alined, so that the blackened tail-piece exactly covered the paper disc. The telescope was also fitted with a diaphragm, consisting of two perpendicular cheeks, which could be adjusted so as to become tangents to the disc. Now, if both pendulums be set in motion,

the detached pendulum vibrating slower than the clock one, the tail-piece will be seen to pass across the diaphragm, followed by the white disc; at each succeeding vibration the disc follows closer and closer, first touching it, and at last becoming completely eclipsed by it. The exact time of this event, called a "disappearance," is noted; after a few more vibrations, the disc will reappear *preceding* the tail-piece; the time of this event, called the "reappearance," is also noted; and the mean of the disappearance and reappearance, is taken as the true time of coincidence. It is immaterial in this method of observation, whether the detached pendulum vibrates faster or slower than the clock pendulum, but it is a *sine quâ non* that its arc of vibration be less. The result, introducing all corrections, except the true one for buoyancy, was 39.13929 inches, which is still the received length, although General Sabine in 1831, showed, by swinging the pendulum in air and in vacuo, that the buoyancy correction was different, according as the heavy weight was above, or below, the plane of suspension.

Captain Kater, in the following year, 1818, made a series of experiments at the principal stations of the English Survey, from Shanklin in the Isle of Wight, to Unst in the Shetlands. He used in these observations a pendulum of a different pattern, known as "Kater's invariable pendulum." With it, it is not possible, nor was it intended, to determine the length of the seconds' pendulum, but it is essentially a differential instrument, and is used for measuring the differences in the number of vibrations at different stations. With these differences, if at any one station the length of the seconds' pendulum has been already determined, the corresponding lengths at the other stations can be ascertained. The invariable pendulum, is of the same dimensions as the convertible one, but is without the second knife edge, and tail-piece, and the sliding weights. The mode of observation is exactly the same. Captain Kater deduced values of the ellipticity, from consecutive pairs of stations; he considered $\frac{1}{304}$ as a probable value (the same as M. Biot's); but he remarks on the difficulty of deriving a satisfactory determination, unless the extreme stations comprise an arc of sufficient extent to render the effects of irregular local attraction insensible.

In 1821-22, some very good observations were made by Mr.

Goldingham, at Madras, and afterwards at a small island called Pulo Gaunsah Lout, lying nearly on the equator in East Longitude 98° 50′. The pendulum used was an invariable one, and observations were first taken with it in London, by Captain Kater. From the observations at Madras and London, Mr. Goldingham deduced an ellipticity of $\frac{1}{297}$.

Captain Basil Hall, assisted by Captain (then Lieutenant) Henry Foster, made a series of experiments with an invariable pendulum in 1820-23, at Galapagos, San Blas (Mexico), Rio Janeiro, and London (Mr. Browne's house). Comparing the results at each of his own stations, with each of Captain Kater's, he deduced ellipticities of $\frac{1}{285}$, $\frac{1}{31}$[illegible] and $\frac{1}{302}$.

In 1822, Sir Thomas Brisbane took with him to Paramatta (near Sydney,) an invariable pendulum that had previously been swung in London, at Mr. Browne's house. He deduced ellipticities of $\frac{1}{296}$ and $\frac{1}{304}$, comparing his observations with those of Kater in London and at Unst.

In 1817, the French Government fitted out a scientific expedition under the command of Captain Freycinet, who was furnished with three invariable brass pendulums, one of which was similar to Captain Kater's pattern, and the other two had solid cylindrical rods instead of a flat bar. He had also a fourth pendulum, with a wooden rod formed of two plates of deal firmly clamped together. Instead of a clock he used an astronomical counter, ("compteur astronomique") whose beats could be adjusted to synchronism with those of the pendulum. The counter had a dial, which showed hours, minutes, and seconds, so that by comparing the time shown by this "compteur" with that of a chronometer, he obtained the number of vibrations made by the pendulum in a certain interval, generally an hour or 40 minutes. The pendulums were first swung at Paris, and afterwards at Rio Janeiro, Mauritius, Guam (one of the Ladrone Islands), Mowi (one of the Sandwich Isles), Cape of Good Hope, Port Jackson, Kawak (an island under the line, north of New Guinea) and Malouine or Falkland Isles. Rejecting the determinations at the Mauritius, Guam and Mowi, as they appeared affected to a remarkable degree by local influences, Captain Freycinet deduced an ellipticity of $\frac{1}{289}$ from all four pendulums.

On the return of Captain Freycinet, the French government sent

out another expedition, under Captain Duperrey. He was supplied with two of Captain Freycinet's brass pendulums, viz. one with a cylindrical rod, and the one on Kater's principle. He observed at six stations, viz. Ascension, Mauritius, Port Jackson, Falkland Isles, Toulon, and Paris. In deducing the ellipticity, he combined his results with those of Freycinet only, and obtained values varying from $\frac{1}{266}$ to $\frac{1}{290}$.

During Ross's voyage to Baffin's Bay in 1818, some observations were taken at Brassa, in the Shetlands, and at Hare Island, with a clock fitted with an invariable pendulum vibrating on a knife edge, which rested on hollow agate cylinders. Observations were repeated at these stations, and a further set taken at Melville Island, on Captain Parry's first voyage to the North Pole in 1819-20. Captain Sabine conducted both these experiments, using the same instruments.

The ellipticity deduced from the experiments at Captain Sabine's stations was $\frac{1}{288.4}$, from the same combined with Kater's $\frac{1}{289.5}$ and combined again with Biot's $\frac{1}{288.6}$ and from a general combination of all of these, $\frac{1}{289.1}$. The observations of the *detached* pendulums only were used in these determinations; for though the clock pendulums gave closely coinciding values of ellipticity, still being acted on by other forces than gravity, their results are less reliable, and are only valuable in so far as they afford an independent corroboration of the other results. Captain Sabine was not at first aware of the strict expression for the reduction to a vacuum, but after the publication of Bessel's observations in 1828, he had an apparatus specially constructed, and ascertained the proper correction practically, by swinging his pendulums in air, and in vacuo.

The error from this cause, however, proved to be trifling, owing to his observations being strictly differential, so that only the differences between the corrections by the old and new formulæ entered.

The most widely differing buoyancy corrections at any of his or Captain Kater's stations of observation, computed by the old formula were + 5.75 vibrations at Sierra Leone and + 6.27 vibrations at Spitzbergen, in a mean solar day. These corrections, multiplied by the proper factor, 1.65, to reduce them to the new formula became + 9.52 and + 10.38 vibrations, so that the number of vibrations in a mean solar day at Sierra Leone required to be increased by (9.52 — 5.75)

3.77, and at Spitzbergen by (10.38 — 6.27) 4.11 vibrations. But the acceleration between the stations would only be *increased* by the difference between these numbers, or by 0.44 vibrations. It so happened, however, that even this difference was too large, for in the deduction of the temperature correction, the old buoyancy formula had of course been used; on applying a correction on this account, the above difference required to be *reduced* by 0.36 vibrations so that the whole error on the acceleration of the pendulum between Sierra Leone and Spitzbergen was only + .08 vibrations.

On this scale a black streak was painted, in the middle of which a space was left white, equal to the diameter of the coincidence cylinder, so that when the pendulum was at rest, the cylinder exactly covered it. Again, to the bottom of the clock pendulum a piece of blackened paper was attached, in which a hole had been cut of such a size that when both pendulums were at rest, it exactly coincided with the image of the white space on the black streak: hence when the pendulums were moving in coincidence, the coincidence cylinder was visible through the hole, and completely eclipsed the white space. Bessel's result was expressed in lines of the toise of Peru, the standard used in the measurement of the Peruvian arc.

In publishing these experiments, M. Bessel pointed out the true correction for buoyancy, which he had investigated by swinging in air two spheres of equal diameters, but of different densities, one being of brass and the other of ivory, suspended by a fine steel wire; and again by swinging the same brass sphere first in air and then in water. These experiments showed that the old formula for reducing observations in air to a vacuum gave too small a correction, and that it should be multiplied by a factor.

Mr. Francis Baily made a long series of experiments on the correction for buoyancy, which were published in the Philosophical Transactions for 1832. He used about 80 pendulums, all differing in form, weight, and mode of suspension. From these experiments he deduced factors for pendulums of almost every description that have ever been used, and computed also the weight of the air adhering to each, in other words deduced the *vibrating* specific* gravity of the

* "The vibrating specific gravity of a compound pendulum is *ordinarily* found "as follows; Let d', d'' d''' ... denote the distance of the centre of gravity of each

pendulum. He concluded from all his results, that even if a pendulum is formed of materials having the same specific gravity, yet if it be not of an uniform shape throughout, each distinct portion must be made the subject of a separate computation, in order to determine the correct vibrating specific gravity of the whole body, since each part will be differently affected by the surrounding air.

The last extensive series of experiments were those taken in 1828-31 by Captain Henry Foster, who was sent out on a scientific mission by the Board of Admiralty. He took out with him four invariable pendulums of different metals, two of Captain Kater's pattern, and two of Baily's convertible pattern. These last consisted of a plain straight bar, 2 inches wide, $\frac{1}{2}$ inch thick, and 5 feet $2\frac{1}{2}$ inches long, having two knife edges 39.4 inches apart, but no heavy bob or sliding weights, as in Captain Kater's pattern; the synchronism was adjusted by filing away at one end of the bar; Baily's intention was, that the pendulum should either be used as two different invariable pendulums, or applied as a single convertible one for absolute determinations, at any station. The objection to the form is, that both the knife edges must be exactly perpendicular to the bar, or error is entailed, as the bar is not flexible like Kater's. Captain Foster swung pendulums at all his stations, 14 in number, which were chiefly in the southern hemisphere. He made a set of observations at Mr. Browne's house before the voyage; on the return of the pendulums to England, they were again swung at the same place, but by Mr. Baily, Captain Foster having been most unfortunately drowned in the River Chagres, in February 1831, just as his mission was completed. His observations were reduced by Mr. Baily, who obtained from them an ellipticity of $\frac{1}{289 \cdot 5}$.

About this time the Russian government sent out an expedition under Captain Lütke, who used an invariable pendulum, formerly used by Captain Basil Hall. He swung it first at Greenwich, and after-

" body respectively from the axis of suspension: w', w'', w''', ... the weight (in air) " of each body: s', s'', s''', ... the specific gravity of each body determined in the " usual manner. Then will the required *vibrating* specific gravity of the pen- " dulum be

$$S = \frac{w' d' + w'' d'' + w''' d''' + \dots}{\frac{w' d'}{s'} + \frac{w'' d''}{s''} + \frac{w''' d'''}{s'''} + \dots}$$

(Philosophical Transactions, 1832.*)*

wards at Ualan, in the Caroline islands, Guam, Bonin island (to the south-east of Japan), at Sitka in Russian North America, at Petropaulowski, Valparaiso, St. Helena, and St. Petersburg. He deduced an ellipticity of $\frac{1}{267}$ from his observations.

Schumacher, the celebrated astronomer of Altona, conducted in 1829-30, a series of experiments with Bessel's apparatus, at the castle of Guldenstein, in order to determine the Danish standard, which was to be a certain fractional part of the length of the seconds pendulum, at the level of the sea, in latitude 45°. In order to estimate the influence of the air, he used, instead of a ball, a hollow cylinder of platinum, made by Repsold, inside which a second solid cylinder, also of platinum, fitted perfectly true. The outer cylinder was closed by covers of the same diameter screwing on to it, which were both perforated; the clamp holding the wire was fastened on to the top, and into the bottom was screwed a point with which the contact was made in measuring the height of the cylinder by the micrometer screw.

The pendulum was swung under four different circumstances, viz. the long pendulum, with and without the inner cylinder, and the short pendulum, also with and without it; and as exactly the same surface was exposed to the air in each case, the influence of it could be computed, which was done by a formula deduced by Bessel. The reduction of the observations was made by Professor Peters. One novelty was introduced, viz. that of computing out the attraction of the ground on which the observations were taken. A square space having a side of 600 toises (1279 yards), in the middle of which the observatory was situated, was subdivided again into 36 squares of 100 toises (213 yards) a side; in each of these borings were made, and specimens of the earth removed and their specific gravities determined; as these were very nearly the same, a mean of the whole was taken. The height of the floor of the pendulum room was 34½ toises (220.6 feet) above the mean sea level, and the attraction of this plateau of the earth's crust introduced a change in the length of the second's pendulum of 0.000215 English inches.

Carlini, whilst measuring the Piedmontese arc in 1821-23, took a series of pendulum experiments at the Hospice on Mount Cenis, with the view of determining the density of the earth. His pendulum was

formed of a heavy sphere suspended by a wire, which was attached to a kind of inverted stirrup; in the part corresponding to the foot plate there was fixed a wheel with a sharp edge turning on its axis. This wheel was placed on a grooved plate and formed the knife edge for suspension; the arrangements for observing were similar to Bessel's. Corresponding observations, though not with the same apparatus, were taken by Biot and Mathien at Bordeaux. The result was a density of 4.95.

One more attempt to determine the density of the earth by means of the pendulum was made in 1854 by the Astronomer Royal, Professor Airy, at the Harton Colliery pit. Two invariable pendulums were set up in the same vertical line, one at the top, the other at the bottom of the pit, and their coincidences with the pendulums of two clocks were simultaneously observed, the relative rates of the clocks being determined by a galvanic apparatus. After each series of coincidences the pendulums were interchanged. The distance between the upper and lower pendulums was 1256 feet; a careful description of the intervening strata was prepared and specimens submitted to Professor W. H. Miller who determined their specific gravities. The acceleration of the seconds' pendulum below was 2.24 seconds per diem, and the resulting mean density of the earth was 6.565.

The best value of the earth's ellipticity as yet deduced from pendulum observations is undoubtedly that of Mr. Baily's. He combined all the observations taken with invariable pendulums, and after applying to them all corrections, obtained a mean ellipticity of $\frac{1}{285\cdot3}$. The latest value of the same, from geodetic observations, is Captain Clarke's, R. E. which includes the new Russian arc and is $\frac{1}{294\cdot36}$. The ellipticity obtained from observations of precession and nutation is $\frac{1}{303\cdot3}$ (Airy's tracts).

The apparatus for the Indian experiments, consists of two invariable pendulums on Kater's principle, a vacuum apparatus with air pump for exhausting, an astronomical clock by Shelton, a good battery of thermometers and a transit instrument. Both pendulums have already done good service: one having been used by General Sabine in his extensive range of experiments, the other by Professor Airy in his Harton pit experiments; they cannot be considered, however, to have retained their original length, as their knife edges have been reground.

Each is composed of a bar of plate brass 1.6 inches wide and rather less than an ⅛th of an inch thick; a strong cross piece of brass is rivetted and soldered to the top to hold the knife edge, which consists of a prism of very hard steel, passing through the bar and adjusted at right angles to its surface. The prism is equilateral in section, but the edge on which it vibrates is ground to an angle of about 120°; the length of the bar from knife edge to the extremity is about 5 feet 1½ inches. At 3′ 2¼″ from the knife edge, a flat circular bob, also of brass nicely turned and pierced in the direction of its diameter, is firmly soldered on; the part of the bar beneath the weight, called the tail-piece, which is about 17″ in length, is reduced to a breadth of 0.7 of an inch and is varnished black, in order to contrast better with the white disc on the clock pendulum, in the observation of the coincidences.

The knife edges rest on agate planes set in a solid brass frame, which is provided with three levelling screws. On the outer side of each plane are Y's, which are moveable in a vertical direction by means of an eccentric; the knife edges rest in them when the pendulum is not in use, and by their means the observer is enabled to lower the pendulum down gently so as to bear always on the same parts of the agate planes. Each pendulum has its own set of planes, and will give different results if swung on any others.

It has been decided to swing the Indian pendulums in vacuo, in order to secure the following advantages. When the pendulum has been set in motion, it will vibrate for a whole day; its temperature will be more equable; it will not be disturbed by currents of air; and errors in the formula for the correction for buoyancy are unimportant. The vacuum apparatus consists of a cylinder of sheet copper about 1 foot in diameter and rather more than 5 feet long, with hemispherical caps, the upper one of glass and moveable, the lower one of sheet copper and soldered to the cylinder. The upper end of the cylinder carries a strong brass plate, to which are attached the frames containing the agate planes and a bar of the same metal and shape as the pendulums; placed side by side with a pendulum inside the apparatus, the bar and pendulum will be of the same temperature, and it is evident that thermometers attached to the former will give the required temperature of the latter. Two delicate thermometers are

attached to the bar, their bulbs being sunk in the metal at points equidistant from each other and the ends of the bar. The stem of the upper thermometer is inverted, and placed side by side with that of the lower thermometer, in order that they may both be viewed through a moderate sized glass plate let into the cylinder. In the lower part of the cylinder there are four other windows, two on the line of the pendulums, to enable their coincidences to be observed; the other two at right angles to these, to give additional light and enable the observer to ascertain whether the detached pendulum is vibrating truly without wabble. There are two scales fixed at right angles to each other, inside the cylinder, on a level with these windows, one of which is used for measuring the arc of vibration of the pendulum, and the other to measure the distance of the pendulum from the former scale, which is necessary to furnish the correction for parallax in the readings of the arc of vibration: it is useful also in placing the pendulum at a constant distance from the clock, which is found convenient in practice.

The upper 4″ of the cylinder is made of greater thickness than the rest, and at top is a strong projecting flange which is intended to rest on a strong cast iron frame made in two pieces, so as to grip the cylinder round the thicker part just below the flange; the halves of the frame are then firmly bolted together with nuts and screws. The upper surface of the flange is ground perfectly true to receive a bell glass, the cap already mentioned, which is like the receiver of an ordinary air pump. The eccentric for raising and lowering the pendulum on to the agate planes passes through a stuffing box in the upper part of the cylinder. Motion is imparted to the pendulums by means of a fork and crutch turned by a spindle which passes through another stuffing box.

The clock with which the vibrations are compared is firmly secured to a wall, and the vacuum apparatus is erected in front, at a distance of about 2 feet from it. The diaphragm for limiting the view of the disc is fitted inside the clock case.

The telescope for observing the coincidences is placed on a small masonry pier at a distance of about 8 feet from the vacuum apparatus and is mounted so as to slide laterally on a graduated horizontal bar; it has also a slight vertical motion. The thermometers and barometers

are read from alongside of this pillar by means of a cathetometer, viz. a telescope sliding up and down on a vertical rod. The object of this is to obviate the ill effects of any defect in the isolation of the apparatus, as well as the influence of the observer's person on the thermometers.

As the disc on the bob of the clock and the tail-piece of the detached pendulum are too far apart to be viewed simultaneously by the telescope, a lens is placed between them, so as to throw the image of the white disc upon the tail-piece of the pendulum. The vacuum cylinder and all its adjuncts, air pump, &c. were made by Adie, and are the only new portions of the apparatus.

The method of operation is as follows. After setting up the clock, the vacuum apparatus is inserted in the iron frame and suspended either on wooden trestles or masonry piers; the frame is roughly levelled; the temperature bar is fixed in position; the agate planes are screwed on firmly to their bed plate, and are very carefully levelled by means of delicate spirit levels provided for the purpose. A pendulum is now inserted and let down upon its planes, but the clock must not yet be set in motion. The telescope is next set up on the prolongation of the line which passes through the two pendulums, when both are at rest. For this purpose it is moved laterally on its graduated support, until a very small portion of the paper disc, on the bob of the clock pendulum, is visible on one side of the tail-piece of the detached pendulum. The reading is noted, and the telescope is then moved in the opposite direction, until an equal portion of the disc is visible on the other side of the tail-piece; the reading is again noted, and the telescope is set to the mean position. The pendulum is then removed, and the diaphragm in the clock case adjusted, until its cheeks are tangents to the disc. The pendulum may now be replaced, and nothing remains to be done but to exhaust the air out of the apparatus and to set the pendulums in motion.

The observations are made in exactly the same way as already described in the account of Captain Kater's apparatus; the times of the disappearance and reappearance are both noted, and the mean taken as the true time of coincidence. The arc of vibration is then determined by noting the reading of the arc, when it is cut by the same edge of the tail-piece on each side of the vertical line. The thermometers and

barometer are read by means of the cathetometer. It is usual to observe not every coincidence, but the first three consecutive coincidences, and then the 11th, 12th, 13th, then the 21st, 22nd, 23rd, and so on; after observing the first two or three, the times of the after coincidences can be easily computed with sufficient accuracy to intimate when the observer should be ready to note them.

It is intended to have observations made generally along the Great Arc at stations 2″ apart in latitude, and at other points where it may be desirable to obtain data regarding local variations in the intensity of gravity.

The pendulum experiments in this country will afford an independent value of the ellipticity of the Indian arc. It is also hoped that they will throw some light on the existing discordance between the astronomical and geodetic latitudes of the Indian survey.

The amount of the deflections of the plumb line, due to the Himalayas and elevated table lands to the north of India, have been computed by Archdeacon Pratt for the different terminal stations of the Indian arcs; but these determinations are so much in excess of the results of the survey, that it is evident that the effects of the mountain attraction must be in a considerable degree compensated, either by a deficiency of density in the strata to the north, or by an excess of density in the strata to the south of the survey stations.

Now the pendulum can undoubtedly be made the means of showing whether the compensation is to be attributed to either of these causes; for, whilst the effect of a distant range of mountains on the vibrations would be quite inappreciable, any local variation in the density of the underlying strata would show itself most unmistakably; so that by taking observations both at a normal station, and at a few points in its vicinity symmetrically situated around it, should there be any considerable excess or defect in the density of the strata to counteract the disturbance due to the mountain mass, the pendulum observations would not fail to point it out.*

Professor Stokes remarks in his letter on these operations: "The pendulum no doubt indicates only the vertical component of the disturbing force, "whereas it is the *horizontal component in the plane of the meridian* that affects "the measures of arcs; at any one station, of course, a horizontal disturbance "may exist without a vertical disturbance, and vice versâ; but in a *system* of "stations disturbances of the one kind must necessarily be accompanied by dis-

The Indian operations will eventually be combined with those taken previously with similar instruments in other parts of the world, to deduce the ellipticity of the earth's mean figure. Both Sir John Herschel and Professor Stokes have remarked, in their letters on the proposed Indian operations, that almost all observations hitherto made have been taken at stations either on islands or coasts, so that a series along the centre of a continent is very much needed. A complete set of observations has been already taken at the Kew observatory by Mr. B. Loewy, with the Indian apparatus; and on the completion of the experiments in this country it will be returned to Kew, in order that final observations may be taken, to show whether the pendulums have undergone any change in the interim.

It is to be hoped, however, that so good an opportunity will not be lost of extending these observations to stations easily accessible from India, though not included within its limits. On this head Professor Miller's opinion may be quoted at length, "Much would be added to the value of the observations made at the stations of the Indian survey, if, before the pendulums were brought back to England, observations could be made with them at some other points, especially points nearer to the equator, such, for instance, as the south coast of Ceylon, Singapore, or on the coast of Borneo. Another accessible point, interesting from being in a long line of depression, where a large gravitation might be expected, is Aden."

The intention of the Russian government, to have similar observations made along the Russian arc, has already been alluded to. If, after the return of the pendulums to England, they were to be swung at one of the Russian stations, it will be possible to combine the Russian with the Indian operations, and deduce a value of the earth's ellipticity from exclusively Continental observations, extending from Cape Comorin to the northernmost part of Finmark.

" turbances of the other kind. Indeed it is theoretically possible, from the vertical disturbances, supposed to be known, *actually to calculate* the horizontal " disturbances, and that without assuming anything beyond the law of universal " gravitation. Actually to carry this out, would probably require observations " to be made at stations more numerous than can be thought of, but the fact of " its possiblity shows how severe a check pendulum observations are capable of " exercising on the results of geodetic observations."

Notes on a collection of Land and Freshwater Shells from the Shan States.—Collected by F. FEDDEN, *Esq.*, 1864-65.—*By* W. THEOBALD, *Junior*, *Esq.*

[Received 17th July, 1865.]

Mr. Fedden having kindly placed in my hands for examination a small collection of shells from the Shan states, I am led to offer the following brief remarks, though I have not the requisite time at my disposal at present, to describe the many novelties which the collection contains, most of which, however, Mr. Benson will shortly describe in the Annals of Natural History. Although the condition of many of the specimens is very poor, for purposes of describing specific characters, and many species are represented by a single individual, still the collection affords conclusive evidence of the great richness in terrestrial mollusca of the region where it was made, and interesting proof of the distribution of some shells, hitherto rather scarce in Indian collections.

Fam. MELANIADÆ.

1. 1 *Melania tuberculata*, Mull. Species.
Large and fine ... 1.90 × 0.60.

2. 2 *M. variabilis* ... Common. Melania, 2.
Of this melania there are five marked varieties, some of which could doubtless be separated specifically by many systematists.

3. 1 *Glabra.* A smooth var. from the tepid springs of Nam-moo. This var., in common with all the others, has the apex but little eroded, and differs but little from the ordinary smooth var. found in Pegu and Bengal.

An average specimen measures 2.00 × 0.75, the measurement being taken along the long axis of the shell, and the transverse diameter of the last whorl.

2*nd*. *Vittata.* This var. is also smooth, but with more convex whorls than the last. The shell too is paler, with a dark median stripe becoming obsolete on the last whorls, but well marked on the earlier ones. Average size 2.00 × 0.75

3*rd*. *Turrita.* A black turrited var. sometimes slightly eroded at the extreme apex, and with the whorls ornamented with two or more,

usually three, series of prominent tubercles, ranged in symmetrical spiral order with four non-tubercular spiral keels on the last whorl towards the mouth. The tubercles form oblique transverse ribs, but the ribs are a subordinate feature to the spiral ornamentation. 2.00 × 0.75.

4th. Pyramidalis. Ornamentation like the last var. but form very squat, with rapidly increasing whorls. The shell is slightly cœrulescent, with four dark brown stripes visible in the interior, corresponding with the spiral keels outside. Columella slightly yellowish, apex but little eroded. 1.90 × 0.85.

Grotto in Nam-mah stream.

2nd. Baccifera. This var. is intermediate in its character between vars. 2 and 3. Its whorls are ornamented with four or five rows of beaded keels, the transverse ribbing being often well marked likewise. Most of the specimens were dead shells. 1.90 × 0.75.

It is noteworthy that the ordinary type of *M. variabilis*, or the huge specimens of the race met with in the Arakan hills, are not represented in the collection, though the abundance of calcareous rocks and calc tuff would, *primâ facie*, lead us to expect shells of similar, if not greater, dimensions. Climate and a lower average temperature of the streams in the Shan country may possibly explain the small size *M. variabilis* there attains, since I have a Maulmein shell which measures 4.00 × 1.30, and Arakan specimens not rarely attain (decollated shells). 3.00 × 1.30.

3. 1 *Paludomus.*

A single specimen of a large paludomus, which I have not yet identified, occurred in the collection.

Fam. PALUDINIDÆ.

4. 1 *Paludina naticordes*, n. s.

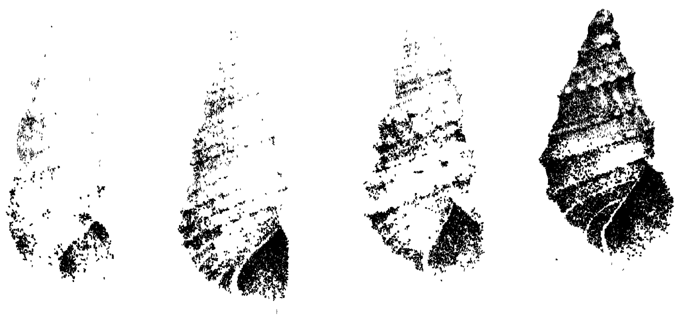
Two marked varieties of this shell occur. A smooth one with one, two or three filiform keels, and a strongly keeled var. with prominent, rugose keels. The species is probably undescribed and may be thus characterised.

P. naticordes, Th.—Testâ turbinatâ, sub-politâ, solidâ, pallide flavescente corneâ ad peripheriam carinâ munita; marginibus callo junctis, callo columellari non raro valde incrassato, umbilicum obtegente.

Varietas fasciata, fasciis duabus castaneis ornatur, hâc superperipheriali, illâ juxta suturam positâ. Anfractu ultimo tertia notest a carinâ

1 ... [illegible] ...

2, 3 d° d° var. [illegible]



4 5

4 Melania var. [illegible]

5 d° d° [illegible]

6 d° d° [illegible]

7 d° d° [illegible]

DRAWN BY T. W. TURNER [illegible]

LITH BY M. SMITH, S. G. CALCUTTA NOV 1865

paulum remota. Callo flavescente, ore interiori cœrulescente. Anfractibus $6\frac{1}{2}$. 1.45 × 1.10

Var. carinata, Carinis quatuor fortissimis supra munitur, et infra peripheriam sex vel quinque lævioribus; colore albido; epidermide flavescente; fasciis nonnullis castaneis interdum ornata. 1.40 × 1.00.

These two varieties pass into each other, but the peculiar columellar callus is pretty constant in all specimens. But for this character, some of the smooth variety might be referred to *P. Bengalensis*, which is an extremely variable species.

The strongly corded var. is well marked, but I have preferred taking the smooth shell as the type of the species, and have regarded the keeled individuals as hypertrophied, placing the greatest value, as a specific character, on the columellar callus, occurring in both varieties.

2. *P. melanostoma.* *Paludina*...... 2.

1. *Bithinia nassa*, n. s.

Testâ elongatâ, turbinatâ, politâ, diaphanâ, solidiusculâ. Labio expansiusculo, plicâ callosâ externâ munitâ. Anfractibus quinque. 0.45 × 0.25.

This is the only species of *Bithinia* in the collection, and it is well characterised by the strong rib-like fold strengthening the lip outside, somewhat as in "nassa."

1. *Ampullaria, sp.*

A small species similar to that found at Maulmein, but distinct from the smaller species met with in the Arakan hills.

An ordinary specimen measures, 1.75. Aperture 1.25. A very large specimen of the Arakan species. 1.45. Aperture 0.95.

Fam. Helicidæ.

Of Helices of all sections, the collection comprises twenty-three species, nearly one half of which seem undescribed.

1. *Helix, n. s.*

A large dextral species of six whorls partaking the characters of *H. interrupta* and *H. semidecussata*, but very distinct from either. All the specimens are unfortunately dead shells. Lat. 1.55 × Alt. 0.75.

2. *H. Blanfordi, Th.*

This species was originally founded on a single shell from Darjiling in my cabinet, which, from its sculpture, I had no hesitation in separat-

ing from its nearest ally *H. cycloplax.* It appears to be a common shell in ths Shan states, though not so in the Eastern Himalayas, but all the specimens are dead shells. They agree well with the type, though a trifle larger and more convex.

3. *Helix ansorinus*, n. s. (MSS.)

A very marked form, but all the shells dead ones.

The sculpture is very ornate and well marked. Shape somewhat as in *H. Peguensis.* 1.20 × 0.60.

4. *H. delibrata*, B.

5. *H.* ......

6. *H.* ......

7. *H.* ......

8. *H.* ...... (approaches *H. Guerini*).

9. *H. sanis*, B.

Though a trifle larger than the type, I can see no sufficient reason for separating this from the Andaman shell. A few dead specimens only are contained in the collection.

10. *H. infula*, B. one or two specimens.

11. *H. attegia*, B. one specimen.

12. *H.* ......

13. *H.* ......

14. *H.* ......

15. *H. similaris*, Fer. *var.*

This shell is somewhat variable. It is usually banded, but occasionally the band is obsolete. It tends to unite *H. Zoroaster*, Th. and *H. bolus*, B., closely approaching the former, but being less depressed and more tumid, though not so globose as the smaller sized *H. bolus*, B. 0.75 × 0.40. Another variety occurs which might be ranked as a large *H. Zoroaster*, Th., but it is not larger than the type of that shell, bnt shows a tendency to approach *H. delibrata*, B. in form and expanded peristome. 0.80 × 0.40.

16. *H. Oldhami*, B.

A little larger than the type which was from near Ava.

17. *H. Huttoni*, Pf.

A single specimen of this widely spread species was in the collection.

18. *H. Arakanensis*, Th. A single specimen of this shell also accompanied the last, a trifle flatter that the type.

19. *H.* ...... *Helix,* 19

1. *Plectopylis,* ...... sp. *Plectopylis,* 1

A described species, but not identified with certainty.

1. *Nanina vitrinoides.*

Abundant.

2. *N. consepta,* B. *Nanina,* 3

Closer armed and one more whorl than the type, which was from near Maulmein.

3. *N.* ....

1. *Streptaxis Birmanica,* Th.

The variety wanting the marginal tooth.

2. *S. Blanfordi,* Th. Three specimens, ... 2

1. *Vitrina* (*Cryptosonea,* Th.) *præstans,* Gould.

Tolerably common.

2. *V.* ....

Type as the last. A small species of the same, ... 2

1. *Bulimus Sinensis.*

A single specimen of this species which is tolerably common in the Pegu forests.

2. *B.* .... of the "*Gracilis*" type, common, with deciduous epidermis.

3. *B.* .... ditto, common.

4. *B. gracilis,*............ common.

5. *B.* ....

6. *B. Niligiricus.*

The occurrence of this shell is very interesting. It has eight whorls and differs slightly from the type, but not to a greater degree than Nilghiri specimens do from one another. *Bulimus,* 6

Achatina...four species.

A. ......

A. ......

A. ......

All of the ordinary Indian type. *Achatina,* 4

Pupa.........In species with new.

P. ....n. s. *Pupa,* 2

1. *Clausilia,* a large species, not rare.

2. *C.* ...... a small species, rather rare.

3. *C.* ...... a larger species, common.

All three seem new species. *Clausilia,* 3

Fam. Limnæidæ.

Lymnæa, a small species, *Lymnæa,* 1

Planorbis Coromandelianus, Fab.

Very common, rather small *Planorbis,* 1

Fam. Diplommatinidæ.

Diplommatina, five species.

As far as a cursory examination enables me to judge, all five seem undescribed: two are sinistral, the others dextral shells.

Diplommatina,... 4

Fam. Cyclostomidæ.

1. *Pterocyclos.*

Probably a new species. Of the type of *P. pullatus,* B., but three-fourths larger.

2. *P. insignis,* n. s.

Formâ typicâ. Testâ albidâ; epidermide flavescente sive castaneâ, deciduâ vestitâ, castaneo-fasciatâ. Peristomate duplici, antice valde expanso. Operculo intus concavo, extra planiusculo, margine valde radiate hirsuto. Lat. 1.20. Lat. oris intus 0.65,

This handsome shell seems tolerably abundant.

Pterocyclos, ... 2

1. *Cyclophorus speciosus,* Phil.

A common species, specimens of medium size.

2. *C. cornu-venatorium,* Sow.

A single specimen occurs in the collection, rather more tumid than Ava specimens.

3. *C.* n. s.

A distinct but not very well defined species, approaching near to *C. excellens,* but wanting the funiculate keel of that species. Only a few dead shells were collected.

4. *C.* n. s.

A single broken specimen, but evidently a new species, recalling in form *C. involvulus,* only larger, and for its size a lighter shell.

5. *C.* n. s. a very minute shell, smaller than *C. Scissimargo.*

Cyclophorus, ... 5

1. *Pupina arula*, B. Two specimens.
2. *P. artata*, B. Two specimens. *Pupina*, ... 2
1. *Alycæus*, n. s. type of *A. Ingrami*, Bl.
2. *A.* n. s. type of *plectocheilus*, B.
3. *A.*
4. *A.*
5. *A. amphora*, B. Two small specimens.
6. *A.* *Alycæus*, ... 6
1. *Pomatias*, n. s.
2. *P.* n. s. near *P. Peguense*, but with more convex whorls.

Pomatias, ... 2

CONCHIFERA.

Fam. Unionidæ.

1. *Unio cæruleus.* Very fine.
2. *U. marginalis.* Fine.
3. Sp. fine. *Unio*, ... 3

One specimen occurs of a unio, remarkable for having two rounded osculating teeth, one in each valve, very near the anterior end. These teeth are smooth and apposed without interlocking. The species is also found in the Pegu Yoma hill streams.

Fam. Cycladidæ.

1. *Corbicula* .... Common.

A small species with yellowish epidermis. *Corbicula*,......... 1

Genera 24, species 77.

Scientific Intelligence.

London, Sept. 17, 1865.

My dear Grote,

As you will doubtless print much of my last letter, I will add a few more items of intelligence concerning matters ornithological, as I have still been steadily engaged in my commentary on Jerdon's work. This has now grown so extensive that I have divided it into four parts, which will probably spread over the *Ibis* for next year. The first three, treating respectively of Jerdon's three volumes, and the fourth, of Ceylon birds, not included by him, and a final tabular expo-

sition of the *Ornis* of the Indian special province of the Indian region. This I divide into 24 districts, and give one to four asterisks to each square, according to the amount of commonness of the species, and a cross where I regard it only as a casual straggler. So that considerable information is conveyed at a glance. I next take up the *Indo-Chinese* or *Ultra-Indian* province, for which I have a fair amount of material. You will have received from Col. Phayre a short note from me respecting the middle-sized Indian Cormorant and one of the Ring-plovers. I now tell you about them more in detail. No. 1006 of Jerdon will stand as *G. fuscicollis*, Stephens: Syn. *sulcirostris*, Brandt (figured in Gould's *B. Austr.)*, *sulcirostris et stictocephalus*, Bonap., *leucogaster*, Meyer (apud Jerdon), *leucotis*, Blyth, *albiventer*, Tickell and *purpuragula*, Peale,—*Sinensis* (apud Jerdon), *G. K. Gray*, *cat. of Nipalese birds*, Jerdon,—a somewhat formidable array of synonyms. Also, one common small Cormorant is the true *pygmæus* of Pallas. Next, about the Ring-plovers. No. 849. This is, as I mentioned, *Æ. curonicus*, (Beseke), *minor*, Meyer, and *Indicus*, Latham: distinct from *Æ. philippensis*, (Scop.), which is a species intermediate to *Æ. curonicus* and *Æ. cantianus*, obtained by Wallace in Borneo, *Æ. philippensis* in nuptial dress, has the usual white forehead surmounted by a black band, also a black loral streak and auriculars in part; crown rufescent-brown with a more rufous periphery; some black behind the nuchal collar above; the black pectoral streak narrow or interrupted in front; and the tail unbanded, with the outermost three feathers white; legs pale in the dry specimens: length of wing 4 inch; of tarse $1\frac{1}{8}$ inch. It should be looked for in S. India. Of No. 850, there are two specimens in the India museum, one of which is the *philippensis* of Sykes's list. After learning of the distinctness of *philippensis* from *curonicus*, I re-examined Horsfield's type specimen of his *pusillus*; and though in bad condition, especially about the nape, I now recognise it as distinct. It is in winter dress, and has not the white collar seen at all seasons in others of the present group. As compared with *curonicus*, the tail is more cuneated, with the dark band considerably less developed, shewing only as a narrow cross stripe on the outermost feathers. Perhaps it is *Ch. Peronii*, Sany., the description of which I have not yet seen. It should also be looked for in S. India. Jerdon omits to include the *Ch. nigrifrons*, (Cuv.), v.

melanops, (Vt.), his *russatus*, an Australian species, of which he obtained a single specimen near Madras in the month of June (*i. e.* during the southern winter), and which is now in the Society's museum: of course an exceedingly rare and accidental straggler. The Indian *Neophron* turns out to be distinct and new, *N. orientalis*, nobis. It is not the *Vultur meleagris* of Pallas, which he describes as a rarity in the Taurian Chersonesus, and which is the black-billed *N. percnopterus*. Four of our rarest *Falconidæ* I have made out to be Japanese species, all priorly named by us 'insulars.' 1. *Accipiter nisoides*, nobis (*gularis*, Schl., of which he notes a specimen from Nipál !)—2. *Buteo aquilinus* (*v. leucocephala*), Hodgson (*hemilasius*, Schl.),—3. *B. plumipes*, H. (*Japonicus*, Schl.),—and 4. *Poliornis pygmæus* (*Buteo pygmæus*, nobis, *B. pyrrhogmys*, Schl.), of which Helfer obtained a specimen in the Tenasserim provinces. *Athene castanotus*, nobis, of Ceylon, is recognised as distinct, from *castanopterus* of Java by Schlegel. Jerdon's No. 145 is not *Tockus gingalensis* (*verus*), but *T. griseus* (*Buceros griseus*, Latham, *B. cineraceus*, Sem.), as distinguished from *T. gingalensis* of Ceylon, which, together with the other, inhabits that island. The two were discriminated by Layard (*Ann. Mag. N. H.* 1854, XIII, 260), though he describes both under *cingalensis*; and he also indicates a second *Hydrocissa* (akin to *H. albirostris* and *H. conoisus*) as inhabiting the mountains of Ceylon. *Spilornis bacha* inhabits Ceylon in addition to *Sp. checla*; and the *Pardalotus pipra* of Lesson is a second Cinghalese *Prionochilus* (seu *Piprisoma*) unknown to Layard. The large crimson *Chrysocoluptes* of Ceylon will rank as *C. Stricklandi* (Layard, v. *carlotta*, Malherbe), erroneously figured by Jerdon in his *Ill. Ind. Orn.* as *Brachypternus Ceylonus!* No. 197 should be *Megalaima Hodgsoni*, Bonap, of N. E. India and the whole Indo-Chinese provinces, as far at least as Cambojia; where the species is mistaken by Schlegel for the Javanese *corvina*, which is wholly unknown in those parts: and *M. viridis* (apud Schlegel), of Java is quite distinct from *M. viridis* (*verus*) o S. India, and is probably the true *lineata*, Vt., as Schlegel himself suggests. He also recognises the identity of No. 42 with the *leucorypha* of Pallas. The latter holds just the same relationship to *H. rustica*, which *H. hyperythra* (of Ceylon) holds to *H. Daurica*; also *Falco rulen* apud Schlegel (the *Sháhia*) to *F. peregrinus*,

Hypotriorchis severus to *H. Subbuteo*, *Tinnunculus rupicolus* (of Africa) to *T. Alaudarius*, and *Athene castanotus* (of Ceylon) to *A. radiatus*. In all these cases the deeper coloured bird is more subtropical, less migratory (or even permanently resident), and does not visit temperate latitudes. Schlegel, with much probability, refers *F. perigrinator*, Sundevall, to *F. macropus*, Swainson (v. *melanogenys*, Gould), the Australian Falcon which occurs in the Malayan province. I think I mentioned that I found a fine female *Falco Babylonicus* in the Worcester Museum; and this is probably the 'Red-naped Falcon,' *F. peregrinoides* apud G. K. Gray, of his Catalogue of the Birds of Nepál. The specimen in Worcester is like an adult female Peregrine, only much paler, with all the markings considerably less developed; nape light cinnamon-rufous marked with dusky; the moustachial streak small; the upper parts cross-banded as in adult Peregrines: this rare Falcon belonging to the Peregrine subgroup, as distinguished from that of the Sakir, Lanan, and Lugger. About *Turnix*, I stated (*in Ibis*, 1865, p. 33) that *Ortygis luzoniensis* of Horsfield's list of Javanese birds was the species I now recognise as *T. tanki* (B. Ham., v. *joudera*, Hodgson); and such a distribution rather puzzled me, as I knew no instance of *T. tanki* out of India proper. It is, however, of a nearly allied but smaller species proper to the Malayan province, described by Wallace from Timor as *T. rufescens*. Thus are here three allied species, *T. maculosus* in the Indo-Chinese province with China, *T. tanki* in the Indian special province, and *T. rufescens* in the Malayan province. The proper name for the Indian Curlew will be *Numenius lineatus*, Cuv.: Syn. *N. Major*, Schlegel.

D. G. Elliot of New York was here the other day, and picked up a few new *Polyplectrons* from Cochin China at Paris. He is about to bring out the *Phasianidæ* in grand style, from drawings by Wolf, some already made, and which you would most heartily admire.

Now for some intelligence about what is doing in the Zoological Gardens, Regent's Park. There are *two* small female African elephants now in London, one of which is safe in the Zoological Gardens. Also a pair of the superb *Gazella Dama*. A fine healthy *Buceros Abyssinicus* (*Abba Gumba* of Appendix to Bruce's Travels), the long-legged ground Hornbill, a most curious kind, which stalks about in a style that would puzzle you altogether to make out

what it was, if you were to see it stepping about at a distance. Emphatically a snake-devourer. Two young Wapitis came to light this week, the daughters of the fine Californian buck! A lot of *Ammoperdix Heyi*; and different species of *Pterocles. Pt. alchata* (I may have told you) has bred, and I saw the newly hatched chick, *præcox* of course, but inactive, from the shortness of its legs. The *Felis macroceles* and two *Ursus Malayanus* which I brought doing well. A pair of common house Mainas at last; and I wish I could see a pair of common Indian crows, and the two common Indian vultures, *Gyps indicus* and *G. bengalensis*. Although the temperature has been extraordinarily high all this September, and people are panting and languishing as if they were in Sierra Leone, I observe with interest and considerable surprise that the Arctic Foxes are rapidly re-assuming their white winter coat! I hear of some extraordinary discoveries up one of the great tributaries of the Amazons, where the few scattered human inhabitants had never before been visited, and were unacquainted with the use of metal, using stone implements; and the animals quite tame and unscared by man—herds of Tapirs, which would allow their coats to be rubbed by a stick and enjoyed the titillation. I just lost a fine thing the other day at Stephens's auction, a splendid skull of *Bubalus brachyceros* had been knocked down for eight shillings; and the purchaser would not part with it. You would otherwise have had it.

P. S.—I have been thinking that you would do well to re-publish my commentary on Jerdon's Birds of India, if you could get Jerdon himself to annotate it, and thus afford him a convenient opportunity, of making known all that he may have to add, in order to complete our information on the subject up to the date of publication in the J. A. S. I much wish to know how his book has sold, and also what progress he is making with the other classes of vertebrata. *N. B. Felis rubiginosa* of the Coromandel Coast extends to Ceylon (Cinghalese specimen in Belfast Museum); and my Cinghalese *Sciurus Layardi* is in the Worcester Museum from Malabar, sent (with *Presbytis Johnii, verus, &c.*) by R. Cole of Madras. Also, in the Worcester Museum, a fine adult female of the rare *Falco Babylonicus*, alleged to be from Java, which I do not believe. I have seen a kitten of my *Felis Jerdoni* from Malabar, and I have little doubt that this jungle-cat there takes the place of *F. rubiginosa* of the Coromandel side of

the Peninsula. I add a list of *desiderata* for the Zoological Gardens. You may smile at my enumerating common Vultures, Kites and Crows, Frogs and Toads; but these are just what are wanted—what nobody thinks of sending. The *Batrachia* might be sent in damp jars, and would endure the voyage without food, though cockroaches might be given to them if available. *N. B.* There are Australian *Rallidæ* and Pelicans in the Zoological Gardens; also *Varanidæ*, *Scincidæ*, and Snakes. Why not also *Indian ?* and operculated Shells (sent with opercle closed) as *Ampullaria* and *Cerithium telescopium ;* even our big *Achatina* with its pseud-opercle closed.

Mammalia. Gibbons—Hunumán Monkey and other species of *Presbytis*—Wild Dog—Indian Wolf—common Bengal Fox, one in Dublin Zoological Gardens, labelled—*Jackal*, *C. aureus !*—*Viverra Zibetha*—*Arctonyx*—Jungle-cats—4-horned Antelope—Gayáls and common Buffaloes (fine, as those of Burma)—Tapir—*Rhinoceros Sondaicus* (from Sunderbáns or Burma) and *Rh. Sumatranus*—any of the Himalayan ruminants—*Tupaia*—*Melogale*—*Pteromys*—*Atherura*—Porcupine from Chittagong or Tippera.

Aves. Lories (any),—common Kites, 2 or 3 (*not* Brahmini)—*Limnaëtus niveus* (of Jerdon's work)—*Pontoaëtus icthyaëtus*—*Spilornis cheela* (especially, to contrast with *Sp. Elgini*)—*Poliornis teesa*—*Aquila fulvescens* (2 or 3 to contrast with the allied African species)—*Aq. hastata*—*Ketupa Ceylonensis*—*Urrua bengalensis*—*U. Coromanda*—*Ninox scutellatus*—*Gyps Indicus* and *G. Bengalensis* (not *Otogyps calvus*. With the exceptions of the two common Bengal species of *Gyps*, the series of Old World Vultures is complete. *N. B. Neophron percnopterus* of Africa has a black bill, in India a *flesh-coloured* bill !)—Barbets—*Centropus rufipennis* (very desirable. *N. B.* The two Indian Coëls are doing well)—*Corvus splendens* and *C. culminatus* (pair of each, especially the former)—*Dendrocitta rufa* (very acceptable—*Bhimraj*—*Sháma*—*Sát Bhai* (*Malacocircus*)—*Báyas* (*Ploceus*, 2 or 3 pairs of each, which would doubtless breed)—*Mainas* of each species, *Sturnopastor*, and especially *Temenuchus*, *pagodarum* (2 or 3 pairs of each)—*Bengal* Jungle-fowls, with white ear-lappet—*Adjutants*, both species—*Ciconia leucocephala*—*Geronticus papillosus*—*Threskiornis melanocephalus*; one already from Siam !—*Gallicrex cristatus*—*Gallinula*

phœnicura—Sarkidiornis melanonotus—Anas pœcilorhyncha—A. caryophyllacea—Fuligula rufina—Pelicanus Philippiensis (small Indian Pelican, common in South India). If Pelicans can be sent from Australia, why not from India? I have mentioned that we have Australian *Rallidæ* alive, and also *Œdicnemus grallarius.* By the way, the *middle-sized* Indian Cormorant still remains an enigma. I have seen no specimen in England, nor is any such species recognised in Schlegel's elaborate notice of the genus. Specimens (skins) of this bird would be most acceptable! It appears to be common in Kashmir.

Tickell's supposed new Gadidous fish is precisely what I told you it would be. There should be a plentiful supply in the museum, several dozens, which I procured in the Akyab bazar. It was described and figured by Richardson, and since by McClelland (who associated it with the *Gadidæ*). I cannot refer just now, but the synonyms in my hand-writing should be on the label attached to the bottle; and that bottle I left near the specimens of *Polynemus*, which Jerdon agreed with me in considering the nearest ally. It just holds that sort of relationship to some of the *Gadidæ*, which the *Scopelidæ* do to the *Salmonidæ ;* only the latter are really more nearly allied, I think. There is a *most interesting Australian Seal* on exhibition at Cremorne, which I am anxious to see, and will do so soon. Vide a notice of it, in a letter from Bartlett to Gray, in a late No. of the Annals. So high a price is wanted for it that the Zoological Secretary has declined to purchase hitherto; but I fear that the exhibition of it brings in some £11 or 12 per week to its proprietor! Of course I have been to see the African Elephant, which differs *very* much from the Asiatic. It is equally docile, but much more energetic and active, and Bartlett considers it the more intelligent of the two! Moreover it is very salacious, which the Asiatic is not (unless when regularly *must*). It was rather in bad case when it arrived, but is now in capital condition. A small African *female* Elephant is expected immediately ; and with it one of the long-legged African ground Hornbills, *Bucorvus Abyssinicus*, or *Abba Gumba* of Bruce. The other Hornbills are doing admirably, *viz.* 3 Homrai, one *B. rhinoceros*, 1 *albirostris*, and one small African *Tockus.* Two or three more of *albirostris* would be acceptable, and as many more *species* as possible, especially the large kinds; for they

shew well in the spacious aviaries allotted to them. The yellow-quilled Porcupine (*Malabaricus*, Sclater,) turns out to be my *H. Bengalensis*, the yellow colour of the quills being only temporary. The 3 handed Armadillo is a most interesting form, very different from *Dasypus*, and considerably akin to *Glyptodon*. There are a fine healthy pair of Chimpanzees, and female Orang-utan; but no Gibbons, which are particularly wanted; especially as there seems every prospect now of these Apes living, as they are so very much better accommodated. The *Gazella dama* lately added to the Garden is a fine acquisition; and Burchell's Zebra has bred. The Eagle you sent has assumed the mature plumage; and I think I may say that *all*, which you have sent, are doing well, the 2 *Mycteriæ*, 2 *Tantali*, also pair of *Hæmatornis Elgini*, and pair of *Eudynamys orientalis* &c. *Gallophasis lineatus* has bred; and there is a young hen ½ *Swinhoei;* also a half-bred Ocellated Turkey. Males of *Phœnicura Reevesii* and *Diardigallus*. Also the *Heliornis* or 'Sun Bittern' (a very curious form); and the black-necked Swans. Bengal Floriken in first-rate summer dress. It was sent by Babu Rajendro Mullick in 1857. How is he getting on, and his store of live-stock? Three living *Apteryx!* Sturgeon still doing well. *Garrulax Sinensis* from China, quite lively and well: the same as the Tenasserim species. The new Cassowary which I described turns out to be the finest of them all. A living female at Amsterdam; and its egg quite different from that of common Cassowary, or of Mooruk. I have seen the magnificent fossil head in the British Museum of *Elephas primigenius* lately dug up near Ilford in Essex, with superb tusks in socket—not curled up as in the Siberian specimens so often figured. Head very different from that of *E. Indicus*, more like *Africanus*, but the grinders are of the same type as the former. Another fine accession to the B. M. is an enormous aërolite from Australia.

I must now tell you a few results of interest at which I have arrived concerning Indian birds. The paper is a very long one, and will probably spread over the *Ibis* for all next year. When I have quite finished it, I contemplate working out the birds of the Indo-Chinese province or sub-region, and then those of the Malayan Peninsula. You may begin by expunging from your list *Cotyle sub-soccata* (identical with *Sinensis*), *Ruticilla phœnicura* (as distinct from *phœnicuroides*), *Phylloscopus trochilus* (disavowed now as Indian by Gould), and I suspect

also *Sturnus unicolor* (for which I believe old spotless specimens of *S. vulgaris* have been mistaken); *Rhodophila melanoleuca*, *Genus* quite identical with *Oreicola*, Bonap., as founded on two Timor species, *melanoleuca* and *luctuosa ;* and therefore I now call the Indian one *O. Jerdoni*, and do not agree that *Pratincola ferrea* should range with it. (Vide Jerdon's Appendix). The *Hororn*is and *Horeites* series puzzled us much. *Hororn*is *fulviventer* = *Phylloscopus fuscatus*, nobis!—*H. fuliginiventro*, also a *Phylloscopus*, akin to last.—*H. flaviventris* a true *Dumeticola ;* and *H. fortipes*, I suspect, another *Dumeticola*, (to judge from my description of Hodgson's specimen in J. A. S. XIV, 585, for I cannot find a specimen in the museums here.) This disposes of the four species admitted by Jerdon; but both in the British and India museums, I find numerous specimens marked *Hororn*is *assimilis*, Hodg., and these are identical with the bird I formerly described as *Drymoica brevicaudata*. Afterwards I thought that this was the adult of *Neornis flavolivocea*, Hodg., of which I had only seen the young; and this view is accepted by Jerdon. It turns out that the two are allied species, and Horsfield's *Sylvia montana* constitutes a third; so I bring these three together under *Neornis*, and sink *Hororn*is altogether. As for *Horeites*, I know but of two species, the large *H. major*, and the small *H. brunneifrons*, (v. *schistilatus*), of which *pollicaris* is the young! Jerdon sends me a new *Dumeticola ;* making 3 (if not 4) of this form, which I think might be very well merged under *Locustella*. Jerdon tells me that my *Accipiter nisoides* is common in the interior of the Himalaya; I can find no specimens, and two that he has sent me (as I presume for this) are decidedly *A. Virgatus*, which he should know well. His new swallow, *Hirundo Tytleri* (in Appendix), I cannot distinguish from *H. cahirica* of Palestine and Egypt; but Adam's species (referred to by Jerdon and *H. fluvicola*) is distinct, and Gould has named it *empusa*. Two species of Woodpecker are confounded under *Chrysocolaptes sultaneus*, viz. true *sultaneus*, H. (*strenuus*, Gould), which is considerably larger, rare, and known only from Nipál; and *C. Delesserti*, Malherbe, from all India, Indo-China, and Malayan Peninsula. *Zoothera imbricata*, Layard—*Oreocincla Nilgiriensis*, nobis. Of Cuckoos, our *Himalayanus* is the *canoroides*, Muller, and *optatus*, Gould; and this species is accepted as *striatus*, Drapeiz, by Schlegel.

It would seem to be the commonest species of the archipelago. Wallace has also *C. poliocephalus* from Java. In the British Museum there is a Nipál specimen of what seems to me a small race of *H. sparverioides*, which I have named *nisoides:* wing 7½ in.—Of *H. nisicolor* I have now seen several specimens. *H. strenuus*, Gould (*B. As.*), I think doubtfully separable from *sparveroides;* and his *hyperythrus* is just the adult of Horsfield's *fugax*, which I consider to be distinct from the Indian *varius*. The *fugax* I now recognise as *H. flaviventris*, (Scopoli. Syn. *C. radiatus*, Gm.; *H. pectoralis*, Cabanis, and *H. hyperythrus*, Gould,—the adult; and *C. fugax*, Horsf., *sparveroides* apud von Schrenck,—the young.)—From China, Philippines, Borneo, and Java. My *Geocichla dissimilis* is *Turdus chrysolaus*, Temm., *nec cardis* (Jerd. No. 358). The *Tragopan Duvaucelii*, Temm., is *Pucrasia castanea*, Gould; and its true habitat probably Kashmir (*Káfiristan* being altogether out of the question). I suspect that *nipalensis*, Gould, is merely a hybrid between it and the common Himalayan species, *Arboricola*. I have made out a list of 12 species of this group! *Turnix Dussumierii* (VERUS) = Sykesi; and *T. Dussumieri* apud Jerdon must stand as *tancki*, B. Ham. (v. *joudera*, Hodgson). *Casarca leucoptera*, nobis, is *Anas scutulata*, Müller.

This must do for the present. I may add that the large striped Derbian Eland has a very different form of ear-conch from the common Eland, broad like that of the Kandoa, instead of lanceolate as in the humped cattle. This is a notable distinction.

NOTE ON THE PEURA PATRIDGES (*Arboricola*, Hodgson). This groud of hill Partridges, with long (or moderately long) straight claws and spurless, is greatly developed in the jungle-clad hills of S. E. Asia and its islands, where probably several species yet remain to be discovered. I think we can already enumerate—

a. With the throat well feathered.

1. A. TORQUEOLA. (Tem., *p. c.* 462-3.) The only species known to me in which the sexes present a marked difference of plumage. Himalaya.

2. A. RUFOGULARIS, nobis. S. E. Himalaya (at a lower altitude than the preceding race,) and also the Tenasserim mountains. (*J. A. S.* XXIV, 276.)

3. A. BRUNNEOPECTUS, Tickell. (*J. A. S.* XXIV, 276.) Tenasserim mountains.

4. A. JAVANICA. (Brown, *J. A. Zool.* pl. XVII; Temm., *p. c.* 1488: but *quære*—the red surrounding the eye?) Java.

5. A. (?) ÆRUGINOSA. (Eyton. *P. Z. S.* 1839, p. 106.) Malayan peninsula.

b. With the throat thinly clad with feathers, shewing the crimson skin beneath.

6. A. PERSONATA. (Horsfield, *Zool. Res.* in Java, fig.; *Tr. Lin. Soc.* XIII, 184.) Sumatra (?) and Java.

7. A. ATROGULARIS, nobis. (*J. A. S.* XVIII, 819; *Perdix olivacea* of Buchanan Hamilton's drawings, not of Gray, Hardw. *Ill. Ind. Zool.*) Hills bordering the valley of the Brahmaputra southward.

8. A. INTERMEDIA, nobis. (*J. A. S.* XXIV, 277.) Probably from Arakan.

9. A. CHARLTONI. (Eyton. *Ann. Mag. N. H.* 1845, XVI, p. 235.) Malayan peninsula: not uncommon about Pinang and Province Wellesley. (Type of *Tropicoperdix*, nobis, *passim*?)

10. A. CHLOROPUS. (Tickell. *J. A. S.* XXVIII, 415, 453,) Tenasserim mountains.

c. With large bare space in front of neck.

11. A. PUNCTULATA. (Hardw. *Ill. Ind. Zool.*) Hab. ——— ?

12. A. CRUDIGULARIS. (Swinhoe, *Ibis*, 1864, p. 426.) Formosa. Type of *oreoperdix*, Swinhoe.

N. B. The *Perdix oculea*, Tem. (*Pig. et Gall.* III, 408; *Tetrao ocellatus*, Raffles, *Tr. Lin. Soc.* XIII, 332; Hardw. *Ill. Ind. Zool.*;) of Mergui province and Sumatra, is the type of my *Caloperdix;* and *P. thoracica*, Tem. (*Pig. et Gall.* III, 335, *P.* and *Arboricola sphenurus*, Gray,) is the type of *Bambusicola*, Gould, to which a second species has been added by Mr. Swinhoe from Formosa, *B. Sonorivox*, Gould. (*B. As.* pt. XVI.)

The Partridges of the *Peura* group are best obtained from natives of the country who understand netting them. Comparatively few fall

to the gun. They rise singly in such difficult places, in steep bamboo-clad hills, that even if occasionally hit by a snap-shot, they are oftener lost than picked up, in localities where a trained dog is an impracticable desideratum: but there are ways of netting them, for I have received from Sylhet several dozens at a time of live *A. atrogularis*; and a lot of *A. torqueola* is similarly now and then obtainable at different hill stations. A pair of *A. torqueola* are now doing well in the Zoological Gardens, Regent's Park, London.

ED. BLYTH.

Erratum in Mr. Parish's paper in Part II. No. III. of the Journal.

Page 139 Line 35, for *Pinus longifolia* read *Pinus Massoniana.*

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1865.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the Sea-level, 18.11 Feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature during the day. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	*Sunday.*							
2	30.083	30.159	30.014	0.115	68.0	77.4	59.2	18.2
3	.090	.158	.046	.112	68.4	77.8	59.2	18.6
4	.151	.222	.105	.117	69.4	78.8	61.2	17.6
5	.150	.238	.099	.139	68.8	77.8	60.4	17.4
6	.113	.209	.047	.162	68.2	77.8	60.5	17.3
7	.055	.137	29.997	.140	68.7	77.5	59.8	17.7
8	*Sunday.*							
9	.075	.156	30.017	.139	68.6	76.8	62.0	14.8
10	.075	.148	.019	.129	65.7	73.4	59.0	14.4
11	.058	.132	29.992	.140	64.6	73.2	57.0	16.2
12	.058	.120	30.010	.110	66.4	75.7	58.6	17.1
13	.073	.136	.026	.110	67.2	76.4	59.2	17.2
14	.105	.178	.051	.127	69.7	79.6	60.6	19.0
15	*Sunday.*							
16	.119	.191	.065	.126	68.8	78.0	61.4	16.6
17	.089	.165	.040	.125	69.0	78.4	60.8	17.6
18	.110	.181	.062	.119	70.0	81.0	60.8	20.2
19	.102	.185	.035	.150	70.7	81.0	60.8	20.2
20	.089	.169	.030	.139	70.1	80.9	61.0	19.9
21	.073	.146	.006	.140	70.6	81.0	62.0	19.0
22	*Sunday.*							
23	.095	.175	.052	.123	71.7	81.2	63.8	17.4
24	.086	.169	.017	.152	72.7	83.0	65.6	17.4
25	.054	.149	29.993	.156	72.4	82.0	64.2	17.8
26	29.979	.053	.908	.145	73.1	83.2	64.1	19.1
27	.914	29.993	.844	.149	73.6	79.1	69.2	9.9
28	.926	30.002	.869	.133	72.8	81.6	66.2	15.4
29	*Sunday.*							
30	30.003	.090	.922	.168	70.9	80.3	62.4	17.9
31	29.973	.050	.908	.142	69.0	77.2	65.5	11.7

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the hourly Observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1865.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued).*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	*Sunday.*							
2	61.6	6.4	56.5	11.5	0.465	5.13	2.40	0.68
3	62 4	6.0	57.6	10.8	.483	.32	.30	.70
4	62.8	6.6	57.5	11.9	.481	.30	.56	.67
5	61.6	7.2	55.8	13.0	.455	.02	.69	.65
6	61.7	6.5	56.5	11.7	.465	.13	.45	.68
7	62.5	6.2	57.5	11.2	.481	.31	.38	.69
8	*Sunday.*							
9	61.9	6.7	56.5	12.1	.465	.13	.54	.67
10	58.7	7.0	53.1	12.6	.415	4.61	.41	.66
11	57.7	6.9	52.2	12.4	.402	.48	.30	.66
12	59.1	7.3	53.3	13.1	.418	.64	.53	.65
13	60.4	6.8	55.0	12 2	.442	.90	.45	.67
14	61.9	7.8	55.7	14.0	.453	.99	.94	.63
15	*Sunday.*							
16	61.3	7.3	55.5	13.1	.450	.97	.70	.65
17	61.6	7.4	55.7	13.3	.453	5.00	.76	.64
18	62.5	7.5	56 5	13.5	.465	.11	.89	.64
19	62.6	8.1	56.1	14.6	.459	.04	3.14	.62
20	62.1	8.0	55.7	14.4	.453	4.99	.04	.62
21	63 2	7.4	57.3	13.3	.478	5.25	2.90	.64
22	*Sunday.*							
23	64.9	6.8	59.5	12.2	.515	.64	.79	.67
24	65.1	7.6	59.0	13 7	.506	.53	3.15	.64
25	64.1	8.3	57.5	14.9	.481	.27	33	.61
26	66.2	6 9	60.7	12.4	.536	.86	2 93	.67
27	68.8	4.8	65.4	8.2	.626	6.84	.09	.77
28	67.2	5.6	62.7	10.1	.572	.26	.45	.72
29	*Sunday.*							
30	62.8	8.1	56.3	14.6	.462	5.07	3.16	.62
31	64.9	4.1	61.6	7.4	.552	6.08	1.68	.78

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	30.068	30.139	29.884	0.255	65.5	70.8	61.4	9.4
1	.061	.134	.878	.256	64.8	71.0	61.0	10.0
2	.052	.128	.872	.256	64.1	70.8	60.6	10.2
3	.041	.113	.869	.244	63.6	70.8	59.0	11.8
4	.046	.112	.883	.229	62.7	66.8	58.8	8.0
5	.047	.130	.890	.240	62.6	70.6	58.0	12.6
6	.068	.149	.910	.239	62.1	70.4	57.4	13.0
7	.090	.180	.938	.242	61.8	70.2	57.0	13.2
8	.118	.210	.963	.247	64.6	70.2	59.4	10.8
9	.136	.235	.983	.252	69.0	74.0	63.8	10.2
10	.140	.238	.993	.245	72.1	75.6	65.0	10.6
11	.121	.210	.976	.234	74.8	78.2	69.0	9.2
Noon.	.094	.173	.938	.235	76.2	80.2	68.0	12.2
1	.060	.138	.917	.221	77.5	81.8	70.0	11.8
2	.038	.117	.890	.227	78.4	83.2	71.8	11.4
3	.019	.111	.868	.243	78.5	83.2	71.2	12.0
4	.013	.110	.848	.262	76.9	81.6	70.6	11.0
5	.020	.119	.844	.275	75.3	79.4	70.2	9.2
6	.027	.134	.862	.272	72.8	76.6	68.4	8.2
7	.041	.149	.870	.279	71.1	75.5	66.4	9.1
8	.057	.161	.932	.229	69.7	74.2	65.2	9.0
9	.067	.175	.912	.263	68.4	73.3	63.6	9.7
10	.070	.178	.883	.295	67.3	72.8	62.4	10.4
11	.071	.171	.950	.221	66.4	72.0	61.8	10.2

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the Observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	Troy grs.	Troy grs.	
Midnight.	60.9	4.6	57.2	8.3	0.476	5.28	1.70	0.76
1	60.5	4.3	57.1	7.7	.475	.27	.56	.77
2	60.1	4.0	56.5	7.6	.465	.18	.49	.78
3	59.7	3.9	56.2	7.4	.461	.14	.43	.78
4	59.0	3.7	55.7	7.0	.453	.06	.33	.79
5	59.1	3.5	55.9	6.7	.456	.09	.28	.80
6	58.5	3.6	55.3	6.8	.447	.00	.27	.80
7	58.3	3.5	55.1	6.7	.444	4.97	.24	.80
8	60.1	4.5	56.5	8.1	.465	5.18	.60	.76
9	62.2	6.8	56.8	12.2	.470	.18	2.58	.67
10	63.7	8.4	57.0	15.1	.473	.18	3.35	.61
11	65.0	9.8	58.1	16.7	.491	.34	.92	.58
Noon.	65.5	10.7	58.0	18.2	.489	.31	4.35	.55
1	65.8	11.7	57.6	19.9	.483	.22	.82	.52
2	66.3	12.1	57.8	20.6	.486	.25	5.06	.51
3	66.1	12.4	57.4	21.1	.480	.18	.17	.50
4	65.3	11.6	57.2	19.7	.476	.16	4.70	.52
5	65.1	10.2	58.0	17.3	.489	.32	.03	.57
6	65.3	7.5	59.3	13.5	.511	.58	3.13	.64
7	64.7	6.4	59.6	11.5	.516	.66	2.62	.68
8	63.9	5.8	59.3	10.4	.511	.63	.30	.71
9	63.1	5.3	58.9	9.5	.504	.56	.06	.73
10	62.4	4.9	58.5	8.8	.498	.50	1.87	.75
11	61.7	4.7	57.9	8.5	.488	.39	.78	.75

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	...	...	*Sunday.*	
2	136.0		N.	Cloudless: also slightly foggy at midnight.
3	137.4	...	S. E. & S. & N. E.	Cloudless: also slightly foggy at 7 A. M.
4	139.0	...	N. W. & N.	Cloudless: also slightly foggy at 10 & 11 P. M.
5	136.2		N. & N. W.	Cloudless.
6	133.0		N.	Cloudless till noon: \i till 5 P. M. cloudless afterwards also foggy at 10 P. M.
7	139.0		E. & N.	Cloudless: also foggy from midnight to 2 A. M.
8	...		*Sunday.*	
9	132.4		N.	Cloudless.
10	132.0		N. & N. W.	└i till 4 A. M. cloudless afterwards.
11	131.8		N. W. & N.	Cloudless till 1 P. M. \i & └i afterwards.
12	133.0		W. & N. W.	└i till 7 A. M. cloudless afterwards.
13	131.4		N. W. & W. & N.	Cloudless: also slightly foggy at 9 & 10 P. M.
14	135.0		N.	Cloudless.
15	..		*Sunday.*	
16	132.4		N. W. & S. & N.	Cloudless till noon: Scatd. clouds till 6 P. M. cloudless afterwards.
17	136.0		W. & N. W.	Cloudless till 8 A. M. └i till 5 P. M. cloudless afterwards: also foggy from 8 to 11 P. M.
18	138.4		W.	Cloudless: to 11 P. M.
19	142.4		W. & N. W.	Cloudless.
20	137.4		S.	\i & └i till 7 A. M. cloudless afterwards.
21	137.0		S. & E. & N.	Cloudless.
22	...		*Sunday.*	
23	134.0		N.	Cloudless till 5 A. M. └i & \i till 6 P. M. cloudless afterwards; also foggy at 6 & 7 A. M. & at 8 & 9 P. M.
24	141.0		N. W. & N.	Cloudless till 4 A. M. \i till 7 P. M. cloudless afterwards.
25	142.2		N. W. & W.	Cloudless till noon: \i & └i till 7 P. M. cloudless afterwards.
26	140.0		S.	Cloudless till 11 A. M. └i till 8 P. M. cloudless afterwards.
		0.16	S. W. & S.	Cloudy: also raining at 3 A. M. 8 & 9 P. M. & thundering & lightning at 8 P. M.
28	139.2		S. W.	Scatd. clouds till 10 A. M. └i afterwards.
29	...		*Sunday.*	
30	133.0		N. & S. & N. W.	Cloudless till 9 A. M. Scatd. clouds till 8 P. M. cloudless afterwards.
31		0.32	S. & N. W.	Cloudless till 5 A. M. cloudy afterwards: also thundering & raining at noon.

\i Cirri, —i Strati, ⌒i Cumuli, └i Cirro-strati, ⌒i Cumulo strati, ⌐i Nimbi ⌐ i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of January, 1865.

Monthly Results.

	Inches
Mean height of the Barometer for the month, ...	30.066
Max. height of the Barometer occurred at 10 A. M. on the 5th, ..	30.238
Min. height of the Barometer occurred at 5 P. M. on the 27th, ..	29.844
Extreme range of the Barometer during the month, ...	0.394
Mean of the Daily Max. Pressures,..	30.143
Ditto ditto Min. ditto, ...	30.008
Mean daily range of the Barometer during the month, ...	0.135

	o
Mean Dry Bulb Thermometer for the month, ...	69.5
Max. Temperature occurred at 2 & 3 P. M. on the 26th, ...	83.2
Min. Temperature occurred at 7 A. M. on the 11th, ...	57.0
Extreme range of the Temperature during the month, ...	26.2
Mean of the daily Max. Temperature, ...	78.9
Ditto ditto Min. ditto, ...	61.7
Mean daily range of the Temperature during the month, ...	17.2

Mean Wet Bulb Thermometer for the month, ...	62.7
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer, ..	6.8
Computed Mean Dew-point for the month, ...	57.3
Mean Dry Bulb Thermometer above computed Mean Dew-point, ..	12.2
	Inches
Mean Elastic force of Vapour for the month, ...	0.478

	Troy grains
Mean Weight of Vapour for the month, ...	5.26
Additional Weight of Vapour required for complete saturation, ..	2.62
Mean degree of humidity for the month, complete saturation being unity,	0.67

	Inches
Rained 2 days, Max. fall of rain during 24 hours, ...	0.32
Total amount of rain during the month, ...	0.48
Prevailing direction of the Wind, ...	N. & N. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of Jaunary, 1865.

Monthly Results.

Tables showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
					No. of days.														
Midnight.	8		1		1		1		3		1		6		5				
1	8		1		1		1		3		1		7		4				
2	6		1		1		1		3		1		7		6				
3	7		2						3	1	1		5		5				3
4	8		1		1				2		2		4		4				4
5	7		1		1				3		1		5		6				2
6	8		1		1				3		2		5		6				
7	8		2		2				2		4		4		4				
8	7		1		1		2		3		2		4		4				2
9	12				1		3		5		2		1		2				
10	10		2		3		1		4		1		3		2				
11	11		3		1		1		3		2		3		2				
Noon.	10		1		3				1		4		1	1	6				
1	9		2		1						2		3		9				
2	13				1						2		1		9				
3	10		1		1						2		4		8				
4	9						1		2		1		3		10				
5	9		1				1		1		2				10				2
6	6		1		1		1		5		1		4		7				
7	7		1		1		1		5		1		4		6				
8	6		1		2		1		4		2	1	5		5				
9	7				2		1		4		2		6	1	4				
10	7				2		1		4		2		6		4				
11	6				2		1		4		3		4		4				2

***Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February,* 1865.**

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Feet.
Height of the Cistern of the Standard Barometer above the Sea-level, 18.11.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature during the day. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	30.002	30.070	29.946	0.124	71.8	79.2	64.4	14.8
2	.043	.106	.993	.113	72.1	79.6	66.6	13.0
3	.036	.115	.986	.129	73.0	81.2	67.4	13.8
4	.007	.086	.933	.153	73.0	81.3	66.2	15.1
5	*Sunday.*							
6	.008	.087	.948	.139	72.4	80.4	64.4	16.0
7	29.986	.092	.909	.183	71.2	80.1	61.2	18.9
8	.907	29.990	.829	.161	74.5	84.6	66.0	18.6
9	.891	.976	.846	.130	72.8	79.5	69.2	10.3
10	.873	.953	.802	.151	73.0	81.2	68.6	12,6
11	.900	.998	.835	.163	70.3	76.0	66.6	9.4
12	*Sunday.*							
13	30.008	30.101	.939	.162	72.8	80.1	67.2	12 9
14	.038	.128	.985	.143	71.5	80.6	62.2	18.4
15	.060	.157	30.015	.142	71.7	81.4	63.8	17.6
16	.062	.139	.004	.135	72.9	83.3	62.6	20.7
17	29.982	.064	29.901	.163	74.8	84.6	65.4	19 2
18	.913	29.986	.851	.135	77.0	87.1	68.0	19.1
19	*Sunday.*							
20	.929	30.025	.876	.149	78.6	87.8	70.2	17.6
21	.903	.002	.826	.176	78.4	86.1	70.6	15.5
22	.888	.000	.830	.170	77.0	85.0	71.1	13.9
23	.940	.040	.853	.187	76.3	85.4	67.6	17.8
24	.963	.066	.870	.196	76.6	87.0	66.2	20.8
25	.949	.058	.880	.178	74.3	80.8	68.8	12.0
26	*Sunday.*							
27	.994	.081	.886	.195	71.6	78.2	67.1	11.1
28	30.065	.157	30.013	.144	72.2	80,2	64.6	15.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the hourly Observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February, 1865.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	67.0	4.8	63.2	8.6	0.582	6.37	2.08	0.75
2	67.0	5.1	62.9	9.2	.576	.31	.22	.74
3	67.3	5.7	62.7	10.3	.572	.26	.50	.72
4	65.0	8.0	58.6	14.4	.499	5.46	3.30	.62
5	*Sunday.*							
6	63.6	8.8	56.6	15.8	.467	.11	.49	.59
7	62.5	8.7	55.5	15.7	.450	4.94	.36	.60
8	69.3	5.2	65.7	8.8	.632	6.89	2.29	.75
9	68.8	4.0	65.6	7.2	.630	.90	1.81	.79
10	69.1	3.9	66.0	7.0	.638	.98	.78	.80
11	66.7	3.6	63.8	6.5	.593	.52	.56	.81
12	*Sunday.*							
13	64.4	8.4	57.7	15.1	.485	5.30	3.41	.61
14	62.8	8.7	55.8	15.7	.455	4.99	.39	.60
15	63.0	8.7	56.0	15.7	.458	5.01	.42	.59
16	64.1	8.8	57.1	15.8	.475	.19	.54	.60
17	66.0	8.8	59.8	15.0	520	.66	.60	.61
18	69.7	7.3	64.6	12.4	.609	6.62	.27	.67
19	*Sunday.*							
20	70.6	8.0	65.0	13.6	.617	.68	.70	.64
21	70.1	8.3	64.3	14 1	.603	.53	.78	.63
22	67.3	9.7	60.5	16.5	.532	5.77	4.12	.58
23	65.5	10.8	57.9	18.4	.488	.29	.40	.55
24	68.1	8.5	62.1	14.5	.561	6.08	3.69	.62
25	67.1	7.2	62.1	12.2	.561	.12	.00	.67
26	*Sunday.*							
27	66.5	5.1	62.4	9.2	.567	.22	2.18	.74
28	63.9	8.3	57.3	14.9	.478	5.23	3.32	.61

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.967	30.053	29.873	0.180	70.2	74.6	66.6	8.0
1	.957	.051	.863	.188	69.5	74.6	65.6	9.0
2	.947	.044	.853	.191	69.1	73.6	64.6	9.0
3	.937	.035	.845	.190	68.7	73.0	64.0	9.0
4	.937	.036	.842	.194	68.1	72.2	63.0	9.2
5	.951	.044	.854	.190	67.4	71.8	62.7	9.1
6	.969	.068	.862	.206	66.8	71.1	62.2	8.9
7	.994	.086	.888	.198	66.7	71.6	61.2	10.4
8	30.023	.112	.913	.199	69.4	74.8	66.0	8.8
9	.048	.141	.945	.196	72.8	78.6	67.8	10.8
10	.059	.157	.953	.204	75.3	81.0	69.0	12.0
11	.048	.157	.917	.240	77.1	83.2	70.6	12.6
Noon.	.020	.134	.904	.230	79.3	85.5	71.4	14.1
1	29.985	.081	.867	.214	80.6	86.4	72.2	14.2
2	.951	.048	.843	.205	81.6	87.0	75.2	11.8
3	.932	.025	.843	.182	81.9	87.8	76.0	11.8
4	.921	.015	.826	.189	81.3	86.8	75.6	11.2
5	.922	.019	.822	.197	79.9	86.0	74.0	12.0
6	.927	.033	.802	.231	77.5	83.0	73.0	10.0
7	.943	.047	.824	.223	75.5	80.6	72.2	8.4
8	.958	.055	.858	.197	74.0	78.8	71.1	7.7
9	.974	.070	.858	.212	72.8	77.3	70.1	7.2
10	.983	.077	.866	.211	71.7	76.4	68.6	7.8
11	.980	.073	.878	.195	70.8	75.2	67.4	7.8

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the Observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	Troy grs.	Troy grs.	
Mid-night.	66.1	4.1	62.8	7.4	0.574	6.32	1.73	0.79
1	65.8	3.7	62.8	6.7	.574	.32	.56	.80
2	65.6	3.5	62 8	6 3	.574	.33	.45	.81
3	65.3	3.4	62.6	6.1	.570	.29	.40	.82
4	64.8	3.3	62.2	5.9	.563	.21	.34	.82
5	64.3	3.1	61.8	5.6	.555	.14	.25	.83
6	63.6	3.2	61.0	5.8	.541	5.99	.27	.83
7	63.6	3.1	61.1	5.6	.543	6.01	.22	.83
8	64.8	4.6	61.1	8.3	.543	5.98	.88	.76
9	65.8	7.0	60.2	12.6	.527	.76	2.95	.66
10	66.7	8.6	60.7	14.6	.536	.82	3.58	.62
11	67.3	9.8	60.4	16.7	.530	.75	4.17	.58
Noon.	67.9	11.4	59.9	19.4	.521	.63	.96	.53
1	68.1	12.5	59.3	21.3	.511	.50	5.51	.50
2	68.5	13.1	59.3	22.3	.511	.49	.85	.48
3	68.3	13 6	58.8	23.1	.503	.39	6.05	.47
4	68.0	13.3	58.7	22.6	.501	.38	5.86	.48
5	67.9	12.0	59.5	20.4	.515	.55	.23	.52
6	68.1	9.4	61.5	16.0	.550	.96	4.08	.59
7	68.0	7.5	62.7	12.8	.572	6 22	3.24	.66
8	67.5	6.5	62.9	11.1	.576	.29	2.75	.70
9	66.8	6.0	62.0	10.8	.559	.11	.60	.70
10	66.5	5.2	62.3	9.4	.565	.20	.23	.74
11	66.1	4.7	62.3	8.5	.565	.20	.00	.76

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	130.9	...	S. W. & variable.	\i & \—i till 3 P. M. cloudy afterwards, also drizzling at 3 A. M. 10 & 11 P. M.
2	139.0	0.10	N. & N. W.	Cloudy till 8 A. M. Scatd. clouds till 5 P. M. cloudless afterwards also drizzling from midnight to 5 A. M. & foggy from 8 to 10 P. M.
3	140.4	...	W.	Cloudy till 3 P. M. cloudless afterwards.
4	139.0	...	N. W. & W.	Cloudless till 3 A. M. cloudy till 8 A. M. \i & \—i afterwards.
5	...	...	*Sunday.*	
6	145.5	...	W. & N. W.	\—i.
7	140.0	...	N. W. & W.	Cloudless till 10 A. M. \i afterwards.
8	137.2	...	S. W. & S.	Cloudless till 8 A. M. ⌒i till 6 P. M. cloudy afterwards also drizzling at 8 & 9 P. M.
9	...	...	S. W. & N. W.	Cloudy till 6 P. M. \i & \—i afterwards; also drizzling at 1 & 9 A. M. & at 1, 5 & 6 P. M.
10	134.8	0.72	S. & N. W.	\i & \—i till 4 A. M. cloudy afterwards, also thundering at 10 A. M. & raining between 10 & 11 A. M. & at 4, 5 & 11 P. M.
11	...	0.20	S. & S. E. & E.	Cloudy: also drizzling after intervals.
12	...	...	*Sunday.*	
13	140.4	...	N. W. & N. & N. E.	\—i till 4 A. M. cloudless afterwards: also slightly foggy at 11 P. M.
14	141.2	...	N. W.	Cloudless.
15	139.5	...	N. W. & W.	Cloudless till 2 A. M. Scatd. clouds till 11 A. M. cloudless afterwards.
16	138.0	...	W. & N. W.	Cloudless.
17	139.2	...	W. & S.	Cloudless till 6 A. M. \i till 10 A. M. \—i till 6 P. M. cloudless afterwards.
18	140.7	...	S. W.	Cloudless till 7 A. M. \i till 6 P. M. cloudless afterwards, also foggy at 5 & 6 A. M.
19	...	...	*Sunday.*	
20	143.0	...	S. & S. E.	Cloudless.
21	141.4	...	N. W. & W.	Cloudless.
22	139.6	...	S. & N. W.	Cloudless till 5 A. M. Scatd. clouds till 2 P. M. cloudless afterwards, also slightly drizzled between 10 & 11 A. M.
23	140.6	...	W. & S. W. & N.	Cloudless.
24	143.0	...	S. W. & S.	Cloudless till 11 A. M. ⌒i till 6 P. M. cloudless afterwards.

\i Cirri, —i Strati, ⌒i Cumuli, \—i Cirro strati, ⌒—i Cumulo strati, ↳—i Nimbi ↳ i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches		
25	139.5	...	E. & variable.	Cloudless till 7 A. M. Scatd. clouds afterwards, also foggy between 4 & 7 A. M. & slightly drizzling at 9 A. M. & 4 P. M.
26	...	0.66	*Sunday.*	
27	136.0	0.18	N. W. & N.	Cloudy nearly the whole day; also thundering and raining between 1 & 2 A. M.
28	138.0	...	N. W.	Cloudless till 5 A. M. \-i till 9 A. M. cloudless afterwards.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February, 1865.

MONTHLY RESULTS.

	Inches
Mean height of the Barometer for the month, ...	29.972
Max. height of the Barometer occurred at 10 & 11 A. M. on the 15th & 28th,	30.157
Min. height of the Barometer occurred at 6 P. M. on the 10th, ..	29.802
Extreme range of the Barometer during the month, ...	0.355
Mean of the Daily Max. Pressures, ...	30.062
Ditto ditto Min. ditto, ...	29.907
Mean daily range of the Barometer during the month, ...	0.155

	o
Mean Dry Bulb Thermometer for the month, ...	73.7
Max. Temperature occurred at 3 P. M. on the 20th, ...	87.8
Min. Temperature occurred at 7 A. M. on the 7th, ...	61.2
Extreme range of the Temperature during the month, ...	26.6
Mean of the daily Max. Temperature, ...	82.1
Ditto ditto Min. ditto, ...	66.5
Mean daily range of the Temperature during the month, ...	15.6

Mean Wet Bulb Thermometer for the month, ...	66.5
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer, ..	7.2
Computed Mean Dew-point for the month, ...	61.5
Mean Dry Bulb Thermometer above computed Mean Dew-point, ..	12.2
	Inches
Mean Elastic force of Vapour for the month, ...	0.550

	Troy grains
Mean Weight of Vapour for the month, ...	6.01
Additional Weight of Vapour required for complete saturation, ..	2.95
Mean degree of humidity for the month, complete saturation being unity,	0.67

	Inches
Rained 10 days, Max. fall of rain during 24 hours, ...	0.72
Total amount of rain during the month, ...	1.86
Prevailing direction of the Wind, ...	N. W. & W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of February, 1865.

Monthly Results.

Tables showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
					No. of days.														
Midnight.					1	1			8		3		4	1	6				2
1	1				1	1			8	2	4		4		6	1			
2	1				1				5		4	1	6		7	1			
3	1				1				2		3		9	2	7				1
4	1						1		1		2		6	1	10	1			3
5	3						1		1		2		7	1	7	1			3
6	3		1		1		1		2		1		8		7				
7	5		2		1				1		3		4		8				
8	6		2		2		1		2		3		2		6				
9	5	1	3		2		2		2	1	3	1	1		6				
10	3		5		2		3	1			4		3		4				
11	3		4		4		2		1	1	1		6		3	1			
Noon.	4		4		2		3		2		3		2		4				
1	5		4		1		1		1		3	1	4		5				
2	1		1		2		2		3		3		4		8				
3	1		1		1		2		1		3		7		8				
4	4				1	1	2		2		2		4		9	1			
5	3		1				1		5	1	2		6	1	6				
6	1				1		2		4	1	5	1	6		5				
7	1				1				5		6		6		5				
8	2				1				4		6	1	6		5				
9	2				1				5		5		4	1	7				
10	2				1				7		4	1	4		6				
11					1				8		2		6	2	7				

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March, 1865.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the Sea-level, 18.11 Feet.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	30.017	30.094	29.957	0.137	73.0	82.3	63.6	18.7
2	29.966	.040	.907	.133	75.9	85.4	66.8	18.6
3	.923	.000	.832	.168	76.9	84.4	70.0	14.4
4	.909	29.971	.820	.151	75.4	83.8	68.8	15.0
5	*Sunday.*							
6	.927	.992	.852	.140	71.6	78.4	68.0	10.4
7	.930	30.021	.867	.154	73.1	81.2	68.1	13.1
8	.929	29.996	.880	.116	72.2	76.0	68.7	7.3
9	.924	30.005	.874	.131	76.4	83.0	69.2	13.8
10	.918	.043	.888	.155	77.9	85.4	72.4	13.0
11	.962	.023	.914	.109	78.3	85.8	71.5	14.3
12	*Sunday.*							
13	.937	.009	.893	.116	79.1	86.7	72.8	13.9
14	.951	.057	.887	.170	76.8	83.8	70.8	13.0
15	.957	.029	.900	.129	76.7	84.3	70.6	13.7
16	30.004	.094	.952	.142	76.9	86.6	68.0	18.6
17	29.998	.090	.937	.153	76.8	87.8	64.9	22.9
18	.961	.039	.886	.153	80.0	91.4	69.2	22.2
19	*Sunday.*							
20	.948	.032	.894	.138	83.3	93.2	73.6	19.6
21	.946	.039	.881	.158	82.9	91.2	75.2	16.0
22	.893	29.975	.819	.156	83.7	94.8	76.8	18.0
23	.859	.948	.774	.174	82.6	94.4	71.8	22.6
24	.838	.908	.790	.118	83.6	94.7	74.6	20.1
25	.848	.925	.795	.130	84.3	96.3	74.0	22.3
26	*Sunday.*							
27	.851	.932	.781	.151	86.3	97.6	76.8	20.8
28	.828	.912	.765	.147	85.7	97.8	76.2	21.6
29	.852	.921	.790	.131	84.5	94.3	78.4	15.9
30	.859	.940	.813	.127	83.8	93.8	76.9	16.9
31	.880	.963	.828	.135	84.6	95.0	76.7	18.3

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the hourly Observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March, 1865.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	64.5	8.5	57.7	15.3	0.485	5.30	3.46	0.61
2	69 3	6.6	64.7	11.2	.611	6.65	2.92	.70
3	69 6	7.3	64.5	12.4	.607	.60	3.26	.67
4	68.7	6.7	64.0	11.4	.597	.50	2.93	.69
5	*Sunday.*							
6	68.5	3.1	66.0	5.6	.638	7.00	1.40	.83
7	69.9	3.2	67.3	5.8	.666	.28	.51	.83
8	68.5	3.7	65.5	6.7	.628	6.88	.67	.81
9	70.9	5.5	67.0	9.4	.659	7.17	2.55	.74
10	72.0	5.9	67.9	10.0	.679	.36	.80	.72
11	72.3	6.0	68.1	10.2	.684	.40	.88	.72
12	*Sunday.*							
13	70.6	8.5	64.6	14.5	.609	6.58	3.95	.63
14	69.6	7.2	64.6	12.2	.609	.62	.21	.67
15	69.0	7.7	63.6	13.1	.590	.40	.40	.65
16	65.9	11.0	58.2	18.7	.493	5.34	4.52	.54
17	65.1	11.7	56.9	19.9	.472	.11	.72	.52
18	66.9	13.1	57.7	22.3	.485	.22	5.59	.48
19	*Sunday.*							
20	70.0	13.3	60.7	22.6	.536	.72	6.21	.48
21	70.5	12 4	61.8	21.1	.555	.95	5.84	.51
22	72.4	11 3	64.5	19.2	.607	6.50	.57	.54
23	72.4	10 2	65.3	17.3	.623	.69	4 99	.57
24	72.7	10.9	65.1	18.5	.619	.63	5.40	.55
25	73.7	10.6	66.3	18.0	.644	.89	.39	.56
26	*Sunday.*							
27	74.6	11.7	66.4	19.9	.646	.88	6.14	.53
28	74.3	11.4	66.3	19.4	.644	.88	5.92	.54
29	77.8	6.7	73.1	11.4	.803	8.60	3.75	.70
30	75.7	8.1	70.0	13.8	.727	7.78	4.32	.64
31	74.4	10.2	67.3	17.3	.666	.12	5.27	.58

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.919	30.054	29.822	0.232	75.0	81.3	68.0	13.3
1	.910	.043	.813	.230	74.3	80.8	67.0	13.8
2	.898	.033	.805	.228	73.7	79.4	65.8	13.6
3	.888	.018	.798	.220	73.2	78.8	65.2	13.6
4	.888	.003	.802	.201	72.7	78.8	64.4	14.4
5	.905	.019	.813	.206	72.2	78.6	64.0	14.6
6	.926	.031	.832	.199	71.7	78.6	63.8	14.8
7	.948	.042	.854	.188	72.3	78.4	63.6	14.8
8	.975	.065	.888	.177	75.4	81.3	68.2	13.1
9	.993	.083	.906	.177	78.8	86.0	68.4	17.6
10	.998	.094	.905	.189	81.7	89.4	68.1	21.3
11	.987	.088	.896	.192	84.2	93.2	74.0	19.2
Noon.	.963	.071	.872	.199	85.9	95.0	74.2	20.8
1	.934	.040	.851	.189	87.1	96.2	75.0	21.2
2	.898	.005	.811	.194	88.0	97.6	76.0	21.6
3	.877	29.977	.776	.201	88.1	97.8	75.6	22.2
4	.867	.965	.770	.195	87.7	97.6	74.9	22.7
5	.865	.959	.765	.194	86.4	96.1	72.6	23.5
6	.872	.957	.777	.180	83.4	91.6	71.8	19.8
7	.888	.969	.791	.178	80.9	88.0	70.8	17.2
8	.906	.988	.812	.176	79.2	85.2	70.2	15.0
9	.918	30.001	.831	.170	78.0	83.8	69.6	14.2
10	.928	.015	.837	.178	77.0	82.2	70.3	11.9
11	.924	.008	.823	.185	76.1	81.4	70.0	11.4

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the Observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	Troy grs.	Troy grs.	
Mid-night.	69.7	5.3	66.0	9.0	0.638	6.95	2.36	0.75
1	69.5	4.8	66.1	8.2	.640	.99	.13	.77
2	69.3	4.4	66.2	7 5	.642	7.01	1.95	.78
3	69.2	4.0	66.0	7.2	.638	6.98	.84	.79
4	68.9	3.8	65.9	6.8	.636	.96	.72	.80
5	68.5	3.7	65.5	6.7	.628	.88	.67	.81
6	68.2	3.5	65.4	6.3	.626	.87	.56	.82
7	68.6	3.7	65.6	6.7	.630	.90	.68	.80
8	70.0	5.4	66.2	9.2	.642	.99	2.44	.74
9	70.9	7.9	65.4	13.4	.626	.77	3.67	.65
10	71.7	10 0	64.7	17.0	.611	.57	4.80	.58
11	72.0	12.2	63.5	20.7	.588	.27	5.97	.51
Noon.	72.0	13.9	62.3	23.6	.565	.01	6.86	.47
1	72 1	15.0	63.1	24.0	.580	.16	7.17	.46
2	72.4	15.6	63.0	25.0	.578	.13	.55	.45
3	72.3	15 8	62.8	25.3	574	.10	.62	.45
4	72.2	15.5	62.9	24.8	.576	.11	.45	.45
5	71.9	14.5	61.7	24.7	.554	5.89	.17	.45
6	71.7	11.7	63.5	19.9	.588	6.29	5.67	.53
7	71.9	9.0	65.6	15.3	.630	.79	4.31	.61
8	71.5	7.7	66.1	13.1	.640	.92	3.64	.66
9	71.2	6.8	66.4	11 6	.646	7.00	.19	.68
10	71.0	6.0	66.8	10.2	.655	.11	2.78	.72
11	70.7	5.4	66.9	9.2	.657	.15	.48	.74

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	137.6	...	W. & N. W.	Cloudless.
2	136.0	...	S.	Cloudless till 9 A. M. Scatd. clouds afterwards.
3	134.0	...	S.	Cloudy till 7 A. M. Scatd. clouds till 8 P. M. cloudy afterwards.
4	135.0	...	S. & N. E.	Cloudy till 10 A. M. ⌒i & ╲—i till 4 P. M. cloudy afterwards.
5	...	1.08	*Sunday.*	
6	...	0.54	E. & N.	Cloudy also raining at midnight & 2 A. M. & drizzling from 4 to 8 P. M. & at 11 P. M. & thundering at midnight & 5 P. M. & lightning at 1 A. M. & at 8 P. M.
7	135.4	0.25	N. & N. W.	Cloudy till 10 A. M. ⌒i till 3 P. M. cloudy afterwards: also raining at 9 & 10 A. M. & drizzling from 5 to 9 P. M.
8	...	...	S. W. & W. & S.	Cloudy: also drizzling at 2, 5 & 7 P. M.
9	137.0	...	E. & W.	Cloudy till 7 A. M. ╲—i & ⌒i afterwards.
10	141.0	0.09	E. & N. E. & N. W.	╲—i till 6 A. M thin clouds till 10 A. M. ╲—i & ⌒i till 5 P. M. cloudy afterwards; also drizzling from 7 to 10 P. M. & lightning at 7 P. M.
11	139.8	...	W. & N. W.	Cloudless.
12	...	...	*Sunday.*	
13	145.8	...	N. W & N.	Cloudless till 3 A. M. ╲—i till 3 P. M. Scatd. clouds afterwards.
14	134.9	...	N. W. & W. & N.	╲i & ╲—i till 2 P. M. Scatd. clouds afterwards.
15	135.0	...	N. W. & N.	╲—i till 4 P. M. cloudless afterwards.
16	140.1	...	W. & N. W.	Cloudless.
17	137.0	...	N. W. & W.	Cloudless till 11 A. M. ╲—i till 3 P. M. ╲i till 6 P. M. cloudless afterwards.
18	141.0	...	W. & N. W.	╲—i till 7 A. M. ╲i till 6 P. M. cloudless afterwards.
19	...	...	*Sunday.*	
20	146.4	...	W. & S. & N. W.	Cloudless till 10 A. M. ╲i & ╲—i till 2 P. M. cloudless afterwards.
21	141.0	...	S. W. & N. W. & S.	╲—i till 1 P. M. ⌒i afterwards.
22	142.2	...	S. W. & W. & S.	╲—i till 4 P. M. cloudy afterwards, also slightly drizzled at 8 P. M. & lightning at 7 P. M
23	142.0	...	S. & N. W.	⌒i till 6 A M. cloudless afterwards.
24	141.0	...	W. & S. W.	Cloudless: also foggy from 3 to 6 A. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲—i Cirro strati, ⌒—i Cumulo strati, ╲⌒—i Nimbi ╲⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches		
25	142.0		S. W. & W.	Cloudless: also foggy from 5 to 8 A. M.
26	..		*Sunday.*	
27	141.6		S. & W. & S. W.	Cloudless.
28	141.0		S.	Cloudless.
29	137.0		S.	Cloudless till 3 P. M. └i afterwards.
30	137.6		S. & S. W.	Cloudless till 8 A. M. \i & └i till 4 P. M. Scatd. clouds afterwards, also raining, thundering and lightning at 8 P. M.
31	144.0		S. W. & S.	Scatd. clouds till 6 A. M. \i & └i till 6 P. M. cloudless afterwards.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March, 1865.

Monthly Results.

	Inches
Mean height of the Barometer for the month, ...	29.920
Max. height of the Barometer occurred at 10 A. M. on the 1st & 16th, ..	30.094
Min. height of the Barometer occurred at 5 P. M. on the 28th, ..	29.765
Extreme range of the Barometer during the month, ...	0.329
Mean of the Daily Max. Pressures, ...	30.000
Ditto ditto Min. ditto, ...	29.859
Mean daily range of the Barometer during the month, ...	0.141

	o
Mean Dry Bulb Thermometer for the month, ...	79.4
Max. Temperature occurred at 3 P. M. on the 28th, ...	97.8
Min. Temperature occurred at 7 A. M. on the 1st, ...	63.6
Extreme range of the Temperature during the month, ...	34.2
Mean of the daily Max. Temperature, ...	88.5
Ditto ditto Min. ditto, ...	71.6
Mean daily range of the Temperature during the month, ...	16.9

Mean Wet Bulb Thermometer for the month, ...	70.7
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer, ..	8.7
Computed Mean Dew-point for the month, ...	64.6
Mean Dry Bulb Thermometer above computed Mean Dew-point, ..	14.8
	Inches
Mean Elastic force of Vapour for the month, ...	0.609

	Troy grains
Mean Weight of Vapour for the month, ...	6.58
Additional Weight of Vapour required for complete saturation, ..	4.04
Mean degree of humidity for the month, complete saturation being unity,	0.62

	Inches
Rained 6 days, Max. fall of rain during 24 hours, ...	1.08
Total amount of rain during the month, ...	1.96
Prevailing direction of the Wind, ...	S. & W. & N. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of March, 1865.

Monthly Results.

Tables showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
					No. of days.														
Midnight.	2								8		7		2		5	1			3
1	3		1						8		5		7		3				
2	1		3	1					8		5		6		4				
3	1		2		1				5		5		8		4				1
4	2		1		1				5		4		8		4				2
5	2		1				1		5		5		8		4				1
6	2		1				1		5		6		9		3				
7	2		1						7		3		11		3				
8	2		1		2				5		6		4		7				
9	3		2		1		1	1	5		5		6		4				
10	4		2		2	1	1		1		7		5		5				
11	4		1		3		1		4		2		7		5				
Noon.	3		1		2		1		4		2		5		9				
1	1				2		1		5		1		6		11				
2	3		1		2				5		2		5	1	9				
3	2		1		2				6				7		9				
4	1	1	1		1				5		4		8		7				
5	2	1	1		2	1			6		3	1	8		5				
6	1	1	2	1	1				9		3		5		6				
7	2	1	2	2	1				10		2	1	5		5				
8	2	1			3	2			9		3	1	7	1	3				
9	1		1	1	2		1		10	1	4		4		4				
10	2				1				12	1	4		4		4				
11	3	1			1				11		5		4		3				

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May, 1865.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the Sea-level, 18 ft. 11 in.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.542	29.609	29.452	0.157	84.9	92.0	77.6	14.4
2	.608	.673	.551	.122	85.6	92.6	79.4	13.2
3	.557	.625	.438	.187	85.9	92.6	78.4	14.2
4	.506	.589	.447	.142	87.4	92.6	83.2	9.4
5	.545	.657	.476	.181	87.0	94.8	80.3	14.5
6	.682	.806	.590	.216	81.9	93.4	73.0	20.4
7	*Sunday.*							
8	.680	.745	.593	.152	79.8	85.6	77.0	8.6
9	.619	.678	.534	.144	81.9	89.8	74.9	14.9
10	.643	.739	.589	.150	79.3	86.3	73.0	13.3
11	.610	.669	.521	.148	84.0	90.5	78.0	12.5
12	.729	.824	.639	.185	79.8	86.6	73.0	13.6
13	.799	.854	.725	.129	83.3	89.0	77.0	12.0
14	*Sunday.*							
15	.707	.781	.598	.183	86.1	92.5	80.2	12.3
16	.712	.775	.639	.136	84.1	92.0	75.6	16.4
17	.754	.826	.684	.142	84.0	92.1	76.8	15.3
18	.764	.823	.701	.122	86.4	92.4	79.6	12.8
19	.786	.851	.716	.135	86.6	93.2	82.0	11.2
20	.767	.844	.674	.170	85.2	92.6	78.4	14.2
21	*Sunday.*							
22	.787	.831	.750	.081	79.8	87.8	76.6	11.2
23	.771	.844	.709	.135	82.4	90.0	77.1	12.9
24	.705	.785	.605	.180	82.1	88.2	76.8	11.4
25	.639	.692	.543	.149	78.8	84.6	76.8	7.8
26	.622	.681	.582	.099	81.1	86.3	78.0	8.3
27	.617	.652	.565	.087	82.3	88.5	79.0	9.5
28	*Sunday.*							
29	.487	.549	.427	.122	84.6	92.2	81.3	10.9
30	.459	.501	.415	.086	85.1	91.5	80.6	10.9
31	.486	.520	.442	.078	83.4	87.8	81.4	6.4

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the hourly Observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May, 1865.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	79 8	5.1	76.2	8.7	0.887	9.49	3.00	0.76
2	79.9	5.7	75.9	9.7	.879	.38	.38	.74
3	80.4	5.5	76.5	9.4	.896	.57	.30	.74
4	82.2	5 2	79.1	8.3	.973	10.36	.09	.77
5	81.0	6.0	77.4	9.6	.922	9.81	.48	.74
6	76.6	5.3	72.9	9.0	.797	8.57	2[illegible]	.75
7	*Sunday.*							
8	76.3	3.5	73.8	6.0	.822	.87	1.88	.83
9	77.3	4.6	74.1	7.8	.830	.92	2.52	.78
10	75.2	4.1	72.3	7.0	.783	.46	.13	.80
11	80.2	3.8	77.5	6.5	.925	9 90	.27	.81
12	75.1	4.7	71.8	8.0	771	8.31	.44	.77
13	77.9	5.4	74.1	9.2	.830	.91	3.02	.75
14	*Sunday.*							
15	79.3	6.8	74.5	11.6	.840	.96	.99	.69
16	78.8	5.3	75.1	9.0	.857	9.17	.04	.75
17	79.4	4.6	76.2	7.8	.887	.51	2 66	.78
18	80.4	6.0	76.2	10.2	.887	.47	3.59	.73
19	80.1	6.5	76 2	10.4	.887	.47	.67	.72
20	78.9	6.3	74.5	10.7	.840	8.98	.63	.71
21	*Sunday.*							
22	77.0	2.8	75.0	4.8	.854	9.22	1.53	.86
23	78.5	3.9	75.8	6.6	.876	.41	2.20	.81
24	78.5	3.6	76.0	6.1	.882	.48	.03	.82
25	76.6	2.2	75.1	3.7	.857	.27	1.17	.89
26	77 8	3.3	75.5	5.6	868	.35	.82	.84
27	79.9	2.4	78.2	4.1	.946	10.17	.41	.88
28	*Sunday.*							
29	81.0	3.6	78.5	6.1	.955	2.3	2.16	.83
30	80.9	4.2	78.0	7.1	.940	.05	.52	.80
31	80.8	2.6	79.0	4.4	.970	.42	1.54	.87

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.661	29.827	29.465	0.362	80.6	85.0	76.8	8.2
1	.651	.811	.458	.353	80.2	85.0	75.4	9.6
2	.635	.804	.447	.357	79.8	85.0	73.0	12.0
3	.642	.806	.463	.343	79 6	84 8	73.6	11.2
4	.630	.808	.445	.363	79.7	83 8	73 2	10.6
5	.651	.824	.449	.375	79.5	84.0	73.6	10.4
6	.667	.826	.468	.358	79.7	83.8	73.6	10.2
7	.681	.832	.477	.355	80.7	84.6	73.0	11.6
8	.693	.842	.475	.367	82.7	87.0	74.2	12 8
9	.705	.854	.492	.362	84.7	88.8	74.3	14.5
10	.702	.851	.497	.354	86.2	90.3	76.0	14.3
11	.692	.843	.482	.361	87.5	92.0	77.9	14.1
Noon.	.671	.827	.473	.354	88.6	92.6	80.8	11.8
1	.650	.806	.445	.361	88.7	93.6	77.3	16.3
2	.625	.784	.427	.357	88.8	94.3	77.5	16.8
3	.605	.773	.418	.355	88.5	94.8	76.4	18.4
4	.587	.750	.415	.335	87 8	94.8	77.3	17.5
5	.592	.759	.423	.336	86.5	94.4	78.0	16.4
6	.601	.753	.429	.324	84.6	90.2	77.8	12.4
7	.626	.771	.446	.325	82.7	87.9	75.6	12.3
8	.645	.773	.454	.319	81.6	87.7	75.6	12.1
9	.661	.786	.469	.317	81.3	86.7	76.3	10.4
10	.678	.815	.486	.329	81 1	85.6	75.8	9.8
11	.674	.824	.473	.351	80.6	85.0	73.0	12.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the Observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	Troy grs.	Troy grs.	
Mid-night.	77.6	3.0	75.5	5.1	0.868	9.37	1.64	0.85
1	77.5	2.7	75.6	4.6	.871	.39	.49	.86
2	77.2	2.6	75.4	4.4	.865	.35	.40	.87
3	77.0	2.6	75.2	4.4	.860	.30	.39	.87
4	77.3	2.4	75.6	4.1	.871	.40	.32	.88
5	77.3	2.2	75.8	3.7	.876	.46	.20	.89
6	77.3	2.4	75.6	4.1	.871	.40	.32	.88
7	77.9	2.8	75.9	4.8	.879	.47	.57	.86
8	78.9	3.8	76.2	6.5	.887	.52	2.20	.81
9	79.9	4.8	76.5	8.2	.896	.59	.83	.77
10	80.4	5 8	76.3	9.9	.890	.50	3.49	.73
11	80.9	6.6	76.9	10.6	.908	.64	.85	.72
Noon.	81 2	7.4	76.8	11.8	.905	.59	4.33	.69
1	81.3	7.4	76 9	11.8	.908	.62	.34	.69
2	81.2	7.6	76.6	12.2	.899	.54	.46	.68
3	80.9	7.6	76.3	12.2	890	.46	.42	.68
4	80.6	7.2	76 3	11.5	.890	.46	.14	.70
5	79.9	6.6	75.9	10.6	.879	.36	3.74	.72
6	79.5	5.1	75.9	8.7	.879	.40	2.99	.76
7	78.4	4.3	75.4	7.3	.865	.30	.42	.79
8	77.6	4.0	74.8	6.8	.849	.13	.21	.81
9	77.7	3.6	75.2	6.1	.860	.26	1.98	.82
10	77.9	3.2	75.7	5.4	.873	.41	.76	.84
11	77.7	2.9	75.7	4.9	.873	.41	.60	.86

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	125.8	0.48	S. (high.)	\—i to 8 A. M. Scatd. ⌒i & \—i to 4 P. M. overcast afterwards. Rain from 7 to 9 P. M.
2	129.0	...	S. & S. W. (high.)	Overcast to 8 A. M. ⌒i to 5 P. M. Scud. afterwards. Thin rain at 1 A. M.
3	123.0	0.39	S. & S. W. (high.)	Overcast to 4 A. M. ⌒i to 10 A. M. Scud to 2 P. M. Overcast afterwards. Rain between 5 & 6 P. M. Thunder & lightning from 7 to 9 P. M.
4	127.8	...	S. (high) & S. E.	\—i to 4 A. M. Scatd. ⌒i & —i afterwards lightning at 8 P. M.
5	132.7	...	S. & S. W.	Overcast to 9 A. M. Scatd. ⌒i & \—i to 5 P. M. overcast lightning & thunder afterwards. Thin rain at 6 A. M. & 7 & 8 P. M.
6	127.0	.. } 1.46	S. E. & S. & E.	Overcast light rain at 6, 7 & 11 P. M. thunder at 6 & 11 P. M. lightning at 11 P. M.
7	...	}	*Sunday.*	
8	124.0	0.36	S. E. & N.	Overcast to 7 A. M. Scatd. ⌒i & \—i to 6 P. M. \—i afterwards. Rain from 1 to 3 P. M. thunder at 2 P. M.
9	125.0	0.62	S. & S. E. & S. W.	\—i & ⌒i to 5 P. M. overcast afterwards. Rain, thunder & lightning at 8 P. M.
10	126.0	1.65	S. & S. W.	Overcast to 11 A. M. Scatd. ⌒i & \—i to 6 P. M. overcast afterwards. Rain from 2 to 7 A. M. thunder & lightning from 1 to 7 A. M.
11	120.0	0.97	S.	Scatd. ⌒i & \—i to 5 P. M. overcast afterwards. Rain at 8 & 9 P. M. thunder & lightning from 7 to 10 P. M.
12	121.6	0.98	S. E. & E. & N. W.	Overcast to 7 A. M. Scatd. ⌒i & \—i afterwards. Rain from 2 to 7 A. M. lightning at midnight & 2 A. M. thunder at 2, 6 & 7 A. M.
13	128.0	...	E. & N. E.	Scatd. ⌒i [illegible]\—i to 4 A. M. \—i to 9 A. M. ⌒i to 5 P. M. cloudless afterwards.
14	...	...	*Sunday.*	
15	135.0	...	S. E. & S.	Cloudless to 4 A. M. \—i to 8 A. M. ⌒i afterwards.
16	133.0	0.71	S. & S. E.	Scatd. ⌒i & \—i to 6 P. M. overcast afterwards. Rain from 6 to 8 P. M. lightning from 8 to 10 P. M.
17	127.0	...	S. & S. W.	Scatd. ⌒i & \—i to 9 A. M. ⌒i to 4 P. M. overcast afterwards, lightning at 9 P. M.

\i Cirri, —i Strati, ⌒i Cumuli, \—i Cirro-strati, ⌒—i Cumulo-strati, \\—i Nimbi \⌒i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches		
18	126.5	...	S. & S. W.	Overcast almost all day: Lightning from 7 to 10 P. M. thunder at 8 & 9 P. M. light rain at 11 P. M.
19	128.0	...	S. & S W.	Scatd. ⌒i & ⌞i to 6 P. M. overcast afterwards.
20	130.0	...	S. & S. E.	Overcast to 6 A. M. ⌒i & ⌞i afterwards.
21	...	...	*Sunday.*	
22	116.0	2.77	S. & S. E.	Scatd. ⌒i & ⌞i whole day, Rain at 6, 8, 10 A. M. 2 & 3 P. M. thunder at 10 A. M. lightning at 9 P. M.
23	131.0	...	S. E. & S. & E.	Scatd. ⌒i & ⌞i to 7 P. M. cloudless afterwards. Thin rain between Noon & 1 P. M.
24	118.0	1.50	S. E. & S.	Cloudless to 3 A. M. Scatd. ⌒i & ⌞i to noon overcast afterwards. Rain at 10 A. M. 1, 5, 6, 8 & 9 P. M. lightning & thunder from 5 to 10 P. M.
25	...	1.08	E. & variable.	Overcast all day. Rain from noon to 5 P.M.
26	121.0	0.10	E. & S. & S. E.	⌞i to 5 A. M. overcast to 7 P. M. ⌒i afterwards, rain between 9 & 10 A. M.
27	130.0	1.02	E. & S. E. & S.	Scatd. ⌒i & ⌞i to 7 P. M. cloudless afterwards. Rain at 3 A. M. noon to 2 P. M.
28	...	...	*Sunday.*	
29	130.0	1.31	S. E. & S. & W.	Scatd. ⌒i & ⌞i to 2 P. M. overcast to 7 P. M. cloudless afterwards. Rain at 1 A. M. & at 4, 5 P. M.
30	130.0	...	E. & variable.	Scatd. ⌒i & ⌞i drizzled at 3 P. M.
31	...	0.54	S. & E. & S. E.	⌞i to 3 A. M. overcast to 5 P. M. Scatd. ⌒i & ⌞i afterwards. Rain from 10 A. M. to 2 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May, 1865.

MONTHLY RESULTS.

				Inches
Mean height of the Barometer for the month, ..		..	..	29.651
Max. height of the Barometer occurred at 9 A. M. on the 13th,			..	29.854
Min. height of the Barometer occurred at 4 P. M. on the 30th,			..	29.415
Extreme range of the Barometer during the month,		..	..	0.439
Mean of the Daily Max. Pressures, ..	..	..	..	29.719
Ditto ditto Min. ditto, ..	..	..	..	29.578
Mean daily range of the Barometer during the month,		..	..	0.141

				o
Mean Dry Bulb Thermometer for the month, ..		..	..	83.4
Max. Temperature occurred at 3 & 4 P. M. on the 5th,		..	..	94.8
Min. Temperature occurred at 7 A. M. on the 10th,		..	..	73.0
Extreme range of the Temperature during the month,		..	..	21.8
Mean of the daily Max. Temperature,	..	..	..	90.3
Ditto ditto Min. ditto, ..	..	..	..	78.0
Mean daily range of the Temperature during the month, ..			..	12.3

Mean Wet Bulb Thermometer for the month, ..		..	..	78.9
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer,			..	4.5
Computed Mean Dew-point for the month,	..	..	..	75.7
Mean Dry Bulb Thermometer above computed Mean Dew-point,			..	7.7
				Inches
Mean Elastic force of Vapour for the month, ..		..	..	0.873

				Troy grains
Mean Weight of Vapour for the month,	..	..	..	9.36
Additional Weight of Vapour required for complete saturation,			..	2.60
Mean degree of humidity for the month, complete saturation being unity,				0.78

				Inches
Rained 22 days, Max. fall of rain during 24 hours,		..	..	2.77
Total amount of rain during the month,	..	..	..	15.94
Prevailing direction of the Wind, ..	..	..		S. & S. E.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of May, 1865.

Monthly Results.

Tables showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
					No. of days.														
Midnight.	1				1		4		13		4		2				1		1
1	1				3		3		13		3		2	1			2	1	
2	1				2		3		15	1	1		1		1	1	2		1
3	1		2		1		6	1	8		4		1	1	1	1	1		2
4			1		2		5		10		3	1	2		1		1		2
5			2	1	5		6		7		3		2		1	1			1
6	1		4	1	5		7		6	1	2				2	2			
7	1		1		8	1	6		8		2				1	1			
8			2	1	8		7		6		4								
9			1		6		9		6		5								
10					7	1	6	1	11	2	3								
11					5		7		10		3		1		1				
Noon.			1	1	3	2	7		11		5								
1					4	2	5	1	9	1	5	1	3		1	1			
2	1	1			3	1	2		11	1	7	1	3	1					
3			1	1	2	1	4	1	14	1	6								
4			2	1	4	1	5		14		2								
5	1		3	2	2	1	7		12		1				1				
6			2	1	3		8	1	11	1	2	1			1				
7	1	1	1		3		9	1	11				1	1	1	1			
8					4		8	1	12	2	2	2	1	1					
9			1		3		6	1	15	2	1						1		
10	1				2		7		16		1								
11	1	1			2		8		12		3	1					1		

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June, 1865.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the Sea-level, 18 ft. 11 in.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.526	29.582	29.491	0.091	83.9	90.8	80.2	10.6
2	.585	.633	.539	.094	84.2	89.0	80.4	8.6
3	.634	.692	.574	.118	87.0	91.4	82.8	8.6
4	*Sunday.*							
5	.646	.701	.571	.130	88.3	93.6	83.4	10.2
6	.663	.722	.593	.129	88.4	94.4	83.2	11 2
7	.670	.740	.589	.151	88.3	94.6	83.8	10.8
8	.617	.688	.539	.149	88.6	94.4	84.2	10.2
9	.517	.569	.433	.136	88.4	93.0	85 0	8.0
10	.491	.567	.449	.118	87.5	91.8	84.0	7.8
11	.572	.628	.511	.117	84.7	87.8	82.8	5.0
12	.581	.632	.510	.122	86.4	95.4	80.0	15.4
13	.523	.572	.447	.125	84.8	92.3	80.5	11.8
14	.478	.524	.418	.106	86.5	92.4	80.8	11.6
15	.481	.526	.446	.080	83.9	86.7	82.0	4.7
16	.495	.541	.439	.102	82.5	87.1	79.6	7.5
17	.456	.488	.411	.077	81.5	83.2	80.4	2.8
18	.451	.533	.405	.128	79.7	81.0	78.6	2.4
19	.561	.642	.495	.147	82.0	86.7	77.0	9.7
20	.643	.700	.597	.103	85.8	91.2	81.4	9.8
21	.636	.674	.580	.094	87.4	93.2	83.1	10.1
22	.615	.662	.567	.095	88.2	93.8	84.0	9.8
23	.573	.619	.502	.117	89.0	95.0	84.2	10.8
24	.543	.607	.491	.116	88.3	96.0	81.0	15.0
25	.538	.600	.471	.129	89.0	96 0	85.4	10.6
26	.567	.605	.510	.095	87.8	94.2	84.2	10.0
27	.552	.613	.468	.145	88.9	95.4	84.3	11.1
28	.500	.551	.408	.143	86.2	89.0	83.4	5.6
29	.433	.492	.370	.122	85.2	90.8	82.2	8.6
30	.417	.507	.352	.155	84.2	88.8	82.0	6.8

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the hourly Observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June, 1865.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	80.9	3.0	78.8	5.1	0.964	10.34	1.79	0.85
2	81.1	3.1	78.9	5 3	.967	.37	.87	.85
3	82.6	4.4	80.0	7.0	1.001	.66	2.63	.80
4	*Sunday.*							
5	82.5	5.8	79.0	9.3	0.970	.31	3.49	.75
6	82.6	5.8	79.1	9.3	.973	.34	.50	75
7	82.7	5.6	79.3	9 0	.979	.40	.40	.75
8	82.9	5.7	79 5	9.1	.986	.47	.45	.75
9	84.0	4.4	81.4	7.0	1 047	11.11	2.73	.80
10	82.9	4.6	80 1	7.4	.005	10 69	.80	.79
11	80.3	4.4	77.2	7.5	0.916	9 79	.63	.79
12	81.6	4.8	78.2	8.2	946	10.09	.97	.77
13	80.8	4.0	78.0	6.8	.940	.05	.41	.81
14	81.6	4 9	78.7	7.8	.961	.24	.86	.78
15	81.4	2.5	79.6	4.3	.989	.60	1.53	.87
16	80.0	2.5	78.2	4.3	.916	.17	.47	.87
17	79.7	1.8	78.4	3.1	.952	.25	.06	.91
18	78 5	1 2	77.7	2.0	.931	.06	0.66	.94
19	79.3	2.7	77.4	4.6	.922	9.91	1.56	.86
20	82.2	3.6	79.7	6.1	.992	10.59	2.24	.83
21	83.2	4.2	80.7	6.7	1.024	.89	.56	.81
22	83.8	4.4	81.2	7.0	.040	11.05	.71	.80
23	84.3	4.7	81.5	7.5	.050	.13	.95	.79
24	83.2	5.1	80.1	8.2	.005	10.67	3.13	.77
25	84.4	4.6	81.6	7.4	.053	11.18	2.90	.79
26	83.3	4.5	80.6	7.2	.021	10.86	.74	.80
27	83.3	5.6	79.9	9.0	0 998	.59	3.45	.75
28	83.1	3.1	80.9	5.3	1.030	.99	2.00	.85
29	81.8	3.4	79.4	5.8	0.983	.49	.12	.83
30	81.5	2.7	79.6	4.6	.989	.58	1.66	.86

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.564	29.681	29.416	0.268	83.9	86.8	79.4	7.4
1	.554	.682	.404	.278	83.5	86 4	78.3	8.1
2	.543	.677	.398	.279	83.2	86.0	78.2	7.8
3	.527	.667	.391	.276	82.9	86.0	78.2	7.8
4	.535	.653	.389	.264	82.9	86.0	77 5	8 5
5	.512	.669	.395	.274	82.9	86.0	77.0	9 0
6	.555	.689	.417	.272	83.0	86.2	77.2	9.0
7	.572	.706	.429	.277	83.7	87.0	78.2	8.8
8	.582	.737	.438	.299	85.1	88.6	79.0	9.6
9	.591	.740	.432	.308	86.5	89.8	79.6	10.2
10	.590	.728	.429	.299	87.8	92.0	80.4	11.6
11	.584	.722	.426	.296	88.8	94.0	79.8	14.2
Noon.	.570	.710	.405	.305	89.8	95.4	79 8	15.6
1	.552	.685	.384	.301	90.3	96.0	80.0	16.0
2	.532	.659	.369	.290	90.4	95.2	79.8	15.4
3	.513	.638	.356	.282	90.4	96.0	79.8	16 2
4	.497	.614	.352	.262	89.6	96.0	79 2	16.8
5	.496	.616	.366	.250	88 6	94.2	79 0	15.2
6	.508	.613	.370	.243	87.3	93 0	78.6	14.4
7	.525	.627	.385	.242	86.1	91.2	79.4	11.8
8	.548	.659	.394	.265	85.2	90.0	80.0	10.0
9	.567	.683	.405	.278	84.8	88.4	80.4	8.0
10	.578	.688	.426	.262	84.4	87.4	80.4	7.0
11	.575	.692	.432	.260	84.2	87.0	80.4	6.6

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the Observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional W[illegible]ght Vapour req[illegible]ed complete sa[illegible]atio[illegible]	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	Troy grs.	Troy grs.	
Mid-night.	81.6	2.3	80.0	3.9	1.001	10.72	1.41	0.88
1	81.3	2.2	79.8	3.7	0.995	.66	.34	.89
2	81.2	2.0	79.8	3.4	.995	.69	.20	.90
3	81.0	1.9	79.7	3.2	.992	.66	.13	.90
4	81.0	1.9	79.7	3.2	.992	.66	.13	.90
5	80.9	2.0	79.5	3.4	.986	.60	.19	.90
6	81.1	1.9	79.8	3.2	.995	.69	.13	.90
7	81.2	2.5	79.4	4.3	.983	.54	.53	.87
8	81.8	3.3	79.5	5.6	.986	.53	2.04	.84
9	82.2	4.3	79.6	6.9	.989	.54	.56	.81
10	82.7	5.1	79.6	8.2	.989	.52	3.08	.77
11	83.1	5.7	79.7	9.1	.992	.53	.47	.75
Noon.	83.1	6.7	79.1	10.7	.973	.30	4.12	.71
1	83.5	6.8	79.4	10.9	.983	.39	.24	.71
2	83.4	7.0	79.2	11.2	.976	.33	.34	.70
3	83.4	7.0	79.2	11.2	.976	.33	.34	.70
4	83.1	6.5	79.2	10.4	.976	.35	3.98	.72
5	82.6	6.0	79.0	9.6	.970	.29	.63	.74
6	82.0	5.3	78.8	8.5	.964	.25	.16	.76
7	82.0	4.1	79.1	7.0	.973	.38	2.57	.80
8	81.7	3.5	79.2	6.0	.976	.43	.18	.83
9	81.7	3.1	79.5	5.3	.986	.55	1.91	.85
10	81.7	2.7	79.8	4.6	.995	.64	.67	.86
11	81.6	2.6	79.8	4.4	.995	.66	.58	.87

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	123.0	0.30	E. & S. E. & S.	Overcast nearly the whole day. Lightning towards S. from 7 to 11 P. M. Rain at 11 P. M.
2	...	0.09	S. & S. W.	Overcast. Light rain between Noon & 1 P. M. Thunder & Lightning at midnight & 1 A. M. 2, 5 & 8 P. M.
3	128.0	...	S. & S. W.	Overcast to 6 A. M. Scud afterwards.
4	...	...	*Sunday.*	
5	129.6	...	S. & S. W.	Cloudless to 7 A. M. ⌒i afterwards.
6	131.0	...	S.	\—i to 6 A. M. ⌒i to 2 P. M. \—i & ⌒i to 7 P. M. Cloudless afterwards.
7	131.0	...	S.	Cloudless to 2 A. M. \—i to 6 A. M. ⌒i to 6 P. M. overcast afterwards.
8	130.0	...	S.	Scud to 9 A. M. ⌒i to 5 P. M. Scud afterwards.
9	124.2	...	S.	Scud to 2 A. M. overcast to 8 A. M. ⌒i & \—i afterwards.
10	124.0	...	S. & S. E.	Overcast to 3 A. M. ⌒i & \—i to 1 P. M. overcast afterwards. Thin rain at 1 A. M.
11	...	...	S. E. & E. & S.	Overcast. Drizzled at 1 A. M.
12	134.0	0.91	S. W. & E.	Light clouds to 6 A. M. \—i & ⌒i to 4 P. M. overcast afterwards. Rain at 6, 8 & 9 P. M. Thunder at 6 P. M.
13	129.6	0.10	S. W. & N. & W.	Overcast to 8 A. M. ⌒i & \—i to 6 P. M. Overcast afterwards, light rain from 7 to 10 P. M.
14	126.8	...	W. & S. W. & S.	Light clouds to 2 A. M. \—i to 11 A. M. ⌒i & \—i afterwards.
15	...	0.53	S. & S. W.	\—i to 3 A. M. overcast afterwards. Rain at 6 & 7 A. M. noon, 3 & 4 P. M.
16	...	1.16	W. & S. W.	Overcast. Rain from 1 to 3 A. M. light rain at 1 P. M. & from 7 to 10 P. M.
17	...	0.14	W. & S. W.	Overcast. Light rain after intervals.
18	...	*2.62	W. & S. W.	Overcast. Rain whole day. Lightning at 10 P. M.
19	...	†1.26	S. W. & S.	Overcast. Light rain from Midnight to 7 A. M.
20	129.0	0.41	S. & S. W.	Overcast to 7 A. M. \i & \—i to 11 A. M. \—i & ⌒i afterwards. Rain at 1 & 4 A. M. & at 5 P. M.

\i Cirri, —i Strati, ⌒i Cumuli, \—i Cirro-strati, ⌒—i Cumulo-strati, ⋁—i Nimbi, ⋁i Cirro cumuli.

* Fell from 9 P. M. of the 17th to Noon of the 18th.

† Fell from 1 P. M. of the 18th to 7 A. M. of the 19th.

Abstract of the Results of the Hourly Meteorological Observations, taken at the Surveyor General's Office, Calcutta, in the month of June, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches		
21	137.5	...	S.	Light clouds to 8 A. M. ⌒i to 4 P. M. ╰i to 7 P. M. cloudless afterwards.
22	130.2	...	S.	Cloudless to 4 A. M. ⌒i afterwards.
23	133.0	...	S.	╰i to 4 A. M.; light clouds to noon, ⌒i afterwards.
24	138.0	0.12	S.	Overcast to 10 A. M. ╲i & ╰i to 4 P. M. ╰i & ⌒i afterwards. Rain at 6 & 7 A. M. Lightning towards W. at midnight.
25	128.0	...	S.	Cloudless to 5 A. M. ⌒i to 3 P. M. overcast to 8 P. M. ⌒i & ╰i afterwards.
26	127.0	...	S. & S. E.	╰i & ⌒i to 3 P. M. overcast afterwards; Lightning towards S. at 8 P. M. Light rain at 9 P. M.
27	137.0	...	S. E. & E.	⌒i & ╰i to 8 A. M. ⌒i to 7 P. M. cloudless afterwards.
28	...	...	E. & S. & variable.	Cloudless to 3 A. M. overcast to 3 P. M. ⌒i & ╰i afterwards: Light rain from noon to 3 P. M.
29	120.8	0.28	E. & N. E.	╰i & ⌒i to 8 A. M. overcast to 6 P. M. ⌒i & ╰i afterwards Rain at 3 P. M.
30	...	0.71	S. E. & N. E. & E.	Overcast. Rain after intervals from noon to 11 P. M.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June, 1865.

MONTHLY RESULTS.

	Inches
Mean height of the Barometer for the month, ...	29.550
Max. height of the Barometer occurred at 9 A. M. on the 7th, ..	29.740
Min. height of the Barometer occurred at 4 P. M. on the 30th, ..	29.352
Extreme range of the Barometer during the month, ...	0.388
Mean of the Daily Max. Pressures, ...	29.607
Ditto ditto Min. ditto, ...	29.489
Mean daily range of the Barometer during the month, ...	0.118

	o
Mean Dry Bulb Thermometer for the month, ...	86.1
Max. Temperature occurred at 4 P. M. on the 24th, ...	96.0
Min. Temperature occurred at 5 A. M. on the 19th, ...	77.0
Extreme range of the Temperature during the month, ...	19.0
Mean of the daily Max. Temperature, ...	91.3
Ditto ditto Min. ditto, ...	82.2
Mean daily range of the Temperature during the month, ...	9.1

Mean Wet Bulb Thermometer for the month, ...	82.1
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer, ..	4.0
Computed Mean Dew-point for the month, ...	79.3
Mean Dry Bulb Thermometer above computed Mean Dew-point, ..	6.8
	Inches
Mean Elastic force of Vapour for the month, ...	0.979

	Troy grains
Mean Weight of Vapour for the month, ...	10.44
Additional Weight of Vapour required for complete saturation, ..	2.51
Mean degree of humidity for the month, complete saturation being unity,	0.81

	Inches
Rained 17 days, Max. fall of rain during 24 hours, ...	2.62
Total amount of rain during the month, ...	8.63
Prevailing direction of the Wind, ...	S. & S. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of June, 1865.

Monthly Results.

Tables showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
								No. of days.											
Midnight.	1		1		1		4		17		3	2	1						1
1	1		1		1		4	1	16	2	4	2	2	1					
2	1		1		1		3		17		3	1	3	2					
3	1				2		2		14		2	1	2	2					6
4	1				3		2		17	1	2	1	4	1					
5	1		2				4		15		3	1	4	2					
6	1		1		3	1	3		15	1	3	1	2	1	1	1			
7	1				3		1		11		6	2	5	2	2	1			
8			3		1		2		10		6		6	1	1				
9	1		1		3		1		11		7		5	1					
10	1		1		4		2		12		4	1	4	1	1				
11	2		2		3		2		12		6	1	1	1	1				
Noon.	1		2	1	4	2	2		12		5	1	3						
1	1		1		2		3	2	13		5	2	2		2	1			
2	2				3	1	4	1	10		5	1	4	1	1				
3			1	1	5	1	2		10		6	1	5	1					
4					5		2		13	1	6	1	3	1					
5			2		3		3		14		7	2							
6			1		4		2		15		5	1	2	1					
7			1		3		4	1	16		4	2			1	1			
8					1		4	1	18	1	4	2	1	1			1		
9					1		3	1	19	2	4	3	1	1			1		
10					1		3		18		5	3	1	1			1		
11					1		5	1	17	1	3	2	1		1		1		

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July, 1865.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the Sea-level, 18 ft. 11 in.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature during the day. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.523	29.581	29.465	0.119	84.3	88.6	80.8	7.8
2	.550	.590	.487	.103	85.2	90.8	81.7	9.1
3	.548	.596	.477	.119	85.5	92.6	82.0	10.6
4	.494	.573	.417	.156	85.0	89.5	82.0	7.5
5	.445	.484	.381	.103	84.6	88.5	81.4	7.1
6	.455	.490	.410	.080	84.6	88.3	81.6	6.7
7	.440	.484	.380	.104	83.7	86.9	81.6	5.3
8	.434	.483	.388	.095	83.4	88.0	80.2	7.8
9	.457	.506	.411	.095	84.2	89.0	81.0	8.0
10	.494	.547	.456	.091	85.4	91.4	81.6	9.8
11	.539	.605	.482	.123	83.8	90.1	78.0	12.1
12	.522	.577	.444	.133	81.4	85.0	78.4	6.6
13	.512	.553	.465	.088	84.2	91.2	81.4	9.8
14	.537	.592	.483	.109	84.8	90.6	79.0	11.6
15	.535	.587	.482	.105	82.6	85.6	79.6	6.0
16	.524	.562	.486	.076	82.5	87.1	79.2	7.9
17	.536	.587	.495	.092	82.7	85.6	80.0	5.6
18	.558	.597	.503	.094	84.2	87.4	81.8	5.6
19	.540	.585	.479	.106	85.4*	90.5	81.4	9.1
20	.582	.631	.536	.095	85.2	88.6	82.6	6.0
21	.598	.656	.537	.119	85.3	88.9	82.9	6.0
22	.604	.655	.557	.098	85.7	90.8	82.5	8.3
23	.640	.699	.585	.114	85.2	89.6	80.2	9.4
24	.687	.739	.628	.111	83.5	89.0	79.8	9.2
25	.725	.774	.666	.108	81.7	83.8	80.2	3.6
26	.719	.772	.678	.094	83.4	88.4	79.5	8.9
27	.708	.758	.659	.099	83.2	87.7	79.8	7.9
28	.749	.803	.700	.103	83.3	87.6	79.4	8.2
29	.759	.798	.707	.091	82.1	85.2	78.5	6.7
30	.714	.772	.646	.126	82.0	88.4	77.4	11.0
31	.678	.726	.601	.125	82.6	88.6	78.8	9.8

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the hourly Observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July, 1865.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—(*Continued.*)

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	81.4	2.9	79.4	4.9	0.983	10.51	1.77	0.86
2	81.9	3.3	79.6	5.6	.989	.56	2.05	.84
3	82.1	3.4	79.7	5.8	.992	.59	.13	.83
4	81.9	3.1	79.7	5.3	.992	.61	1.92	.85
5	81.8	2.8	79.8	4.8	.995	.64	.75	.86
6	81.4	3.2	79.2	5.4	.976	.45	.94	.84
7	80.7	3.0	78.6	5 1	.958	.28	.79	.85
8	80.1	3.3	77.8	5.6	.934	.01	.95	.84
9	79.8	4.4	76.7	7 5	.902	9.64	2.60	.79
10	81.0	4.4	77 9	7.5	.937	10.00	.68	.79
11	80.5	3.3	78.2	5.6	.946	.13	1.97	.84
12	79.5	1.9	78.2	3.2	.946	.19	.08	.90
13	81.3	2.9	79.3	4.9	979	.48	.76	.86
14	81.3	3 5	78.8	6.0	.964	.31	2.15	.83
15	80.4	2.2	78.9	3.7	.967	.39	1 29	.89
16	79.9	2 6	78.1	4.4	.943	.14	.50	.87
17	79.9	2.8	77.9	4.8	.937	.06	.66	.86
18	81.4	2.8	79.4	4.8	.983	.51	.73	.86
19	81.3	4.1	78 4	7.0	.952	.17	2.51	.80
20	81.8	3.4	79.4	5.8	.983	.49	.12	.83
21	81.8	3.5	79.3	6.0	.979	.46	.18	.83
22	81.5	4.2	78 6	7.1	.958	.23	.57	.80
23	81.1	4.1	78.2	7.0	.946	.11	.50	.80
24	80.8	2.7	78.9	4.6	.967	.37	1.63	.86
25	79.7	2.0	78.3	3 4	.949	.22	.15	.90
26	80.7	2 7	78.8	4.6	.964	.34	.62	.87
27	80.4	2.8	78.4	4.8	.952	.21	.68	.86
28	80.7	2.6	78.9	4.4	.967	.39	.54	.87
29	79.6	2.5	77.8	4.3	.934	.05	.46	.87
30	79.6	2.4	77.9	4.1	.937	.08	.39	.88
31	79.7	2.9	77.7	4.9	.931	.00	.68	.86

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month. Max.	Min.	Diff.	Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month. Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.587	29.778	29.432	0.346	82.1	84.0	77.4	6.6
1	.574	.761	.421	.340	82.0	83.8	77.9	5.9
2	.563	.756	.410	.346	81.9	83.8	77.8	6.0
3	.554	.737	.395	.342	81.7	83.4	77.8	5.6
4	.561	.740	.393	.347	81.6	83.5	77.8	5.7
5	.561	.752	.388	.364	81.5	83.4	77.9	5.5
6	.577	.765	.409	.356	81.[illegible]	83.0	78.0	5.0
7	.591	.777	.421	.356	82.2	84.0	79.2	4.8
8	.604	.790	.438	.352	83.6	85.4	80.2	5.2
9	.615	.803	.476	.327	84.7	87.5	81.8	5.7
10	.615	.803	.469	.334	85.8	88.9	81.9	7.0
11	.608	.798	.457	.341	86.5	90.4	80.8	9.6
Noon.	.595	.788	.444	.344	86.8	91.4	82.2	9.2
1	.576	.768	.431	.337	87.4	92.6	82.6	10.0
2	.553	.737	.413	.324	87.2	91.4	83.2	8.2
3	.535	.729	.380	.349	87.1	91.2	83.1	8.1
4	.525	.711	.381	.330	86.2	90.0	81.4	8.6
5	.527	.708	.381	.327	85.8	89.4	80.2	9.2
6	.535	.739	.384	.355	84.4	87.6	79.4	8.2
7	.553	.753	.414	.339	83.2	86.4	79.8	6.6
8	.577	.771	.431	.340	82.9	8[illegible].8	79.4	6.4
9	.594	.789	.445	.344	82.4	84.8	78.6	6.2
10	.606	.793	.458	.335	82.3	84.6	78.0	6.6
11	.606	.784	.468	.316	82.2	84.4	78.1	6.3

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the Observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	Troy grs.	Troy grs.	
Midnight.	80.1	2.0	78.7	3.4	0.961	10.35	1.16	0.90
1	80.0	2.0	78 6	3.4	.958	.32	.15	.90
2	79 9	2.0	78.5	3.4	.955	.29	.15	.90
3	79.7	2.0	78.3	3.4	.949	.22	.15	.90
4	79.6	2.0	78[illegible]	3.4	.946	.19	.15	.90
5	79.6	1.9	78.3	3.2	.949	.22	.09	.90
6	79.7	1.9	78.4	3.2	.952	.25	.09	.90
7	80.1	2.1	78.6	3.6	.958	.30	.24	.89
8	80.8	2.8	78.8	4.8	.964	.34	.69	.86
9	81.2	3.5	78 7	6.0	.961	.29	2.13	.83
10	81.6	4.2	78.7	7.1	.961	.26	.57	.80
11	81.9	4.6	79.1	7.4	.973	.38	.72	.79
Noon.	82.0	4.8	79.1	7.7	.973	.36	.85	.78
1	82.5	4.9	79.6	7.8	.989	.52	.93	.78
2	82.4	4 8	79.5	7.7	.986	.49	.88	.79
3	82.4	4.7	79.6	7.5	.989	.52	.81	.79
4	82.0	4.2	79.1	7.1	.973	.38	.61	.80
5	81.7	4.1	78.8	7.0	.964	.29	.54	.80
6	80.9	3.5	78.4	6.0	.952	.19	.12	.83
7	80.4	2.8	78.4	4.8	.952	.21	1.68	.86
8	80.3	2.6	78.5	4.4	.955	.27	.52	.87
9	80.1	2.3	78.5	3.9	.955	.27	.34	.89
10	80.1	2.2	78.6	3.7	.958	.30	.28	.89
11	80.1	2.1	78.6	3.6	.958	.30	.24	.89

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	113.8	0.60	S. E. & E.	⌒i & ╲_i. Rain after intervals.
2	129.4	0.43	S. E. & E. & S.	⌒i & ╲_i. Rain at 1 A. M. noon 4, 6 & 8 P. M.
3	123.4	0.20	N. E. & S. E.	⌒i & ╲_i. Rain at 2 & 4 P. M.
4	125.4	0.21	N. E. & E.	Overcast to 10 A. M. ⌒i afterwards. Thin rain after intervals.
5	...	0.43	S. E.	Overcast to 3 P. M. ⌒i afterwards. Rain occasionally.
6	...	...	S.	Scud from S. to 5 A. M. Overcast to 1 P. M. ⌒i & ╲_i afterwards. Thin rain at 6 A. M. & noon.
7	...	0.25	S.	⌒i & ╲_i to 11 A. M. ╲⌒_i to 5 P. M. ╲i & ⌒i afterwards. Thin rain at 5 A. M. from noon to 3 P. M. & at 11 P. M.
8	...	...	S.	╲⌒_i to 11 A. M. [illegible]o 7 P. M. ╲⌒_i afterwards. Ligh[illegible]in from 6 to 8 A. M.
9	119.6	...	S.	╲⌒_i to [illegible] P. M. ╲_i afterwards. Thin rain at 10 A. M. & 4 P. M.
10	127.5	0.18	S. & S. W.	╲⌒_i to 7 A. M. ╲_i & ⌒i to 4 P. M. ╲⌒_i afterwards. Rain from 7 to 9 P. M.
11	...	2.43*	S. & S. W.	⌒i to 6 A. M. ╲_i & ⌒i to noon: ╲⌒_i to 7 P. M. Overcast afterwards. Rain between 1 & 2 P. M. & from 4 to 11 P. M. Lightning towards W. at 11. P. M.
12	...		S. & S. E.	╲⌒_i nearly the whole day. Rain after intervals. Lightning towards W. at midnight.
13	114.0	0.57	S.	⌒i & ╲_i to 2 P. M. ╲⌒_i afterwards. Rain from 3 to 6 P. M.
14	119.0	2.79	S.	⌒i & ╲⌒_i to 9 A. M. ⌒i to 7 P. M. ╲⌒_i afterwards. Rain from 6 to 9 P. M.
15	...	0.35	S. & S. W.	Overcast nearly the whole day. Rain from 5 to 8 A. M.
16	...	0.31	S.	Overcast nearly the whole day. Rain after intervals.
17	...	0.11	S. E. & S.	Overcast nearly the whole day. Thin rain at 8 A. M. & from 10 to 1 P. M.
18	114.5	...	S. E.	Overcast to 5 A. M. ⌒i & ╲_i to 6 P. M. Cloudless afterwards. Light rain at midnight, 1 & 9 A. M.

╲i Cirri, —i Strati, ⌒i Cumuli, ╲_i Cirro-strati, ⌒_i Cumulo-strati, ╲⌒_i Nimbi, ╲⌒i Cirro cumuli.

* Fell on the 11th & 12th.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches		
19	121.0	...	S. & S. E.	Cloudless to 5 A. M. ⌒i & \i to 3 P. M. \⌒i to 7 P. M. cloudless afterwards.
20	115.0	0.33	S. & S. E.	Cloudless to 4 A. M. \i & ⌒i to 7 A. M. \⌒i to 2 P. M. _i & ⌒i afterwards Rain at 11 A. M. 1 & 7 P. M.
21	121.5	0.39	S. & S. E.	\i & _i to 9 A. M. ⌒i & Scud. from S to 4 P. M. Overcast to 8 P. M. cloudless afterwards. Rain at 5 P. M.
22	119.0	...	S.	Cloudless to 4 A. M. ⌒i & _i to 7 P. M. Overcast afterwards.
23	124.4	0.15	S.	Overcast to 5 A. M. ⌒i & Scud from S. to 5 P. M. \⌒i afterwards. Thin rain between 7 & 8 A. M. & at 9 & 10 P. M.
24	119.0	0.52	S.	\⌒i to 2 A. M. \i & Scud from S. to 10 A. M. Overcast afterwards. Rain between noon & 1 P. M. & from 4 to 11 P. M.
25	...	0.15	S.	Overcast. Rain from 7 to 11 A. M. & from 3 to 11 P. M.
26	130.1	0.53	S.	Overcast nearly the whole day. Rain at midnight & 1 & 10 A. M. & from 5 to 9 P. M.
27	121.0	...	S.	Overcast to 2 P. M. ⌒i & _i afterwards. Light rain from 7 to 10 A. M. & between 6 & 7 P. M.
28	112.6	0.25	S.	Overcast to 9 A. M. ⌒i to 5 P. M. Overcast afterwards. Light rain at 4, 6, 7 A. M. 4 P. M. & from 6 to 10 P. M.
29	...	} 1.01*	S.	Overcast, drizzled after intervals.
30	119.7		S. & W.	Overcast to 8 A. M. \⌒i afterwards. Light rain from midnight to 3 A. M. & at 3 & 6 P. M.
31	...	...	S. & W.	Overcast nearly the whole day. Lightning & Thunder from 5 to 9 P. M. Rain from 2 to 11 P. M.

* Fell on the 29th & 30th.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July, 1865.

Monthly Results.

	Inches
Mean height of the Barometer for the month, ...	29.575
Max. height of the Barometer occurred at 9 & 10 A. M. on the 28th, ..	29.803
Min. height of the Barometer occurred at 3 P. M. on the 7th, ..	29.380
Extreme range of the Barometer during the month, ...	0.423
Mean of the Daily Max. Pressures, ...	29.625
Ditto ditto Min. ditto, ...	29.519
Mean daily range of the Barometer during the month, ...	0.106

	o
Mean Dry Bulb Thermometer for the month, ...	83.9
Max. Temperature occurred at 1 P. M. on the 3rd, ...	92.6
Min. Temperature occurred at Midnight on the 30th, ...	77.4
Extreme range of the Temperature during the month, ...	15.0
Mean of the daily Max. Temperature, ...	88.5
Ditto ditto Min. ditto, ...	80.5
Mean daily range of the Temperature during the month, ...	8.0

Mean Wet Bulb Thermometer for the month, ...	80.8
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer, ..	3.1
Computed Mean Dew-point for the month, ...	78.6
Mean Dry Bulb Thermometer above computed Mean Dew-point, ..	5.3
	Inches
Mean Elastic force of Vapour for the month, ...	0.958

	Troy grains
Mean Weight of Vapour for the month, ...	10.28
Additional Weight of Vapour required for complete saturation, ..	1.85
Mean degree of humidity for the month, complete saturation being unity,	0.85

	Inches
Rained 29 days, Max. fall of rain during 24 hours, ...	2 79
Total amount of rain during the month, ...	12.19
Prevailing direction of the Wind, ...	S. & S. E.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of July, 1865.

Monthly Results.

Tables showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
								No. of days.											
Midnight.			1		1		5		22	4	2	1							
1			1		1	1	7	2	20	3	2	1							
2			1		1		6	1	21	1	1								1
3			1				7		21		1		1	1					
4					1		6	1	18	2	1								5
5			1				8	1	21	2	1	1							
6			1		2		4		22	3	2	1							
7			2		1		7		19	4	2	1							
8			2	1			8	1	17	5	3	1	1						
9			2				6	1	20	4	2		1						
10			2	1			6	2	20	3	2		1						
11			2				6	2	18	3	4	1	1						
Noon.			2	1	1	1	7	1	20	5	1								
1			2	1	1		6	1	21	5	1								
2			2	1	2	1	5	1	20	2	2	1							
3			2		1		5	2	21	6	2								
4			2	1	2	1	6	1	20	6	1								
5			1		1		7	2	22	7									
6			1		2	1	6	1	18	6	1		3	3					
7			1		1		4		20	8	3	2	2	2					
8			1		1		3		28	7			3	3					
9			1		1	1	6	2	19	5	2	2	2	2					
10			1		1		7	2	19	5	1		2	2					
11			2				5	3	21	3	2	1	1	1					

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1865.

Latitude 22° 33′ 1″ North. Longitude 88° 20′ 34″ East.

Height of the Cistern of the Standard Barometer above the Sea-level, 18 ft. 11 in.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Date.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer during the day.			Mean Dry Bulb Thermometer.	Range of the Temperature during the day.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
1	29.885	29.974	29.802	0.172	84.9	96.4	75.0	21.4
2	*Sunday.*							
3	.843	.908	.789	.119	83.6	94.6	78.4	16.2
4	.842	.918	.735	.183	83.8	98.2	73.4	24.8
5	.885	.947	.811	.136	80.4	90.0	72.4	17.6
6	.814	.888	.737	.151	83.6	93.0	77.0	16.0
7	.786	.878	.715	.163	85.3	94.6	79.0	15.6
8	.788	.853	.731	.122	87.5	96.5	81.6	14.9
9	*Sunday.*							
10	.811	.885	.746	.139	87.5	96.8	80.4	16.4
11	.825	.908	.771	.137	86.2	96.6	80.2	16.4
12	.872	.949	.785	.164	85.1	93.6	78.2	15.4
13	.897	.985	.833	.152	84.3	92.1	75.2	16.9
14	.877	.964	.794	.170	85.4	94.6	79.2	15.4
15	.816	.885	.731	.154	85.7	95.2	79.6	15.6
16	*Sunday.*							
17	.729	.795	.675	.120	81.5	90.8	76.4	14.4
18	.824	.905	.716	.189	82.6	92.4	75.4	17.0
19	.879	.969	.809	.160	84.4	92.5	78.2	14.3
20	.761	.852	.664	.188	85.4	93.6	79.6	14.0
21	.701	.778	.622	.156	86.2	94.8	80.6	14.2
22	.744	.795	.673	.122	79.6	91.1	73.4	17.7
23	*Sunday.*							
24	.714	.786	.647	.139	82.5	91.0	76.2	14.8
25	.706	.786	.629	.157	85.7	93.8	79.8	14.0
26	.736	.808	.653	.155	86.4	92.6	81.4	11.2
27	.782	.845	.693	.152	84.6	91.4	77.9	13.5
28	.729	.802	.637	.165	85.6	91.6	80.6	11.0
29	.639	.715	.526	.189	85.0	90.6	75.8	14.8
30	*Sunday.*							

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the hourly Observations made during the day.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1865.

Daily Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Date.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	T. gr.	T. gr.	
1	78.2	6.7	73.5	11.4	0.814	8.70	3.79	0.70
2	*Sunday.*							
3	74.8	8.8	68.6	15.0	.695	7.44	4.59	.62
4	75.5	8.3	69.7	14.1	.720	.71	.39	.64
5	72.6	7.8	67.1	13.3	.661	.13	3.81	.65
6	77.8	5.8	73.7	9.9	.819	8.78	.25	.73
7	79.3	6.0	75.1	10.2	.857	9.15	.49	.72
8	80.8	6.7	76.8	10.7	.905	.61	.88	.71
9	*Sunday.*							
10	78.0	9.5	72.3	15.2	.783	8.32	5.17	.62
11	77.6	8.6	71.6	14.6	.766	.15	4.81	.63
12	77.7	7.4	72.5	12.6	.787	.41	.16	.67
13	75.1	9.2	68.7	15.6	.697	7.44	.84	.61
14	77.6	7.8	72.1	13.3	778	8.31	.37	.66
15	77.8	7.9	72.3	13.4	.783	.36	.44	.65
16	*Sunday.*							
17	74.9	6.6	70.3	11.2	.734	7.90	3.41	.70
18	75.9	6.7	71.2	11.4	.756	8.12	.56	.70
19	77.8	6.6	73.2	11.2	.806	.63	.68	.70
20	78.3	7.1	73.3	12.1	.809	.63	4.05	.68
21	79.9	6.3	75.5	10.7	.868	9.25	3.74	.71
22	75.2	4.4	72.1	7.5	.778	8.39	2.30	.79
23	*Sunday.*							
24	78.8	3.7	76.2	6.3	.887	9.54	.10	.82
25	80.8	4.9	77.4	8.3	.922	.85	.95	.77
26	80.8	5.6	76.9	9.5	.908	.66	3.40	.74
27	78.9	5.7	74.9	9.7	.851	.09	.30	.73
28	79.3	6.3	74.9	10.7	851	.08	.68	.71
29	78.6	6.4	74.1	10.9	.830	8.87	.66	.71
30	*Sunday.*							

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.

Hour.	Mean Height of the Barometer at 32° Faht.	Range of the Barometer for each hour during the month.			Mean Dry Bulb Thermometer.	Range of the Temperature for each hour during the month.		
		Max.	Min.	Diff.		Max.	Min.	Diff.
	Inches.	Inches.	Inches.	Inches.	o	o	o	o
Mid-night.	29.806	29.904	29.700	0.204	80.3	83.4	73.6	9.8
1	.793	.899	.686	.213	79.9	83.0	73.8	9.2
2	.780	.884	.673	.211	79.5	82.6	74.0	8.6
3	.770	.878	.642	.236	79 2	82 6	73.8	8.8
4	.771	.875	.646	.229	79.1	82.8	72 8	10.0
5	.790	.898	.651	.247	78.5	82.6	72.8	9.8
6	.804	.913	.652	.261	78.5	82.4	72.4	10.0
7	.826	.930	.659	.271	79.6	84.0	72.6	11.4
8	.848	.962	.675	.287	82.2	85.4	76.0	9.4
9	.863	.974	.697	.277	85.2	87.8	79.4	8.4
10	.864	.985	.686	.299	87.6	89.6	82.0	7.6
11	.854	.971	.673	.298	89.7	92.7	84.0	8.7
Noon.	.830	.953	.651	.302	91.2	94.6	85.7	8.9
1	.799	.936	.623	.313	92.3	97.0	86.4	10.6
2	.769	.917	.598	.319	92.8	97.4	88.4	9.0
3	.744	.883	.558	.325	92.6	98.2	84.0	14.2
4	.729	.855	.543	.312	91.0	97.8	75.0	22.8
5	.725	.836	.526	.310	89.6	96.2	73.8	22.4
6	.740	.843	.539	.304	86.6	93.4	73.6	19.8
7	.763	.900	.599	.301	84.2	90.8	72.8	18.0
8	.784	.927	.647	.280	82.9	86.8	73.8	13.0
9	.805	.931	.694	.237	81.7	85.0	73.8	11.2
10	.815	.906	.648	.258	81.4	84.4	73.6	10.8
11	.811	.919	.648	.271	80.5	84.4	73.4	11.0

The Mean Height of the Barometer, as likewise the Dry and Wet Bulb Thermometer Means are derived from the Observations made at the several hours during the month.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1865.

Hourly Means, &c. of the Observations and of the Hygrometrical elements dependent thereon.—*(Continued.)*

Hour.	Mean Wet Bulb Thermometer.	Dry Bulb above Wet.	Computed Dew Point.	Dry Bulb above Dew Point.	Mean Elastic force of Vapour.	Mean Weight of Vapour in a Cubic foot of air.	Additional Weight of Vapour required for complete saturation.	Mean degree of Humidity, complete saturation being unity.
	o	o	o	o	Inches.	Troy grs.	Troy grs.	
Midnight.	76.6	3.7	74.0	6.3	0.827	8.93	1.98	0.82
1	76.6	3.3	74.3	5.6	.835	9.01	.77	.84
2	76.3	3.2	74.1	5.4	.830	8.98	.68	.84
3	76.1	3.1	73.9	5.3	.824	.92	.64	.85
4	76.4	2.7	74.5	4.6	.840	9.09	.44	.86
5	75.6	2.9	73.6	4.9	.819	8.84	.51	.85
6	75.8	2.7	73.9	4.6	.824	.92	.43	.86
7	76.4	3.2	74.2	5.4	.832	9.00	.69	.84
8	77.7	4.5	74.5	7.7	.840	.03	2.51	.78
9	78.7	6.5	74.1	11.1	.830	8.87	3.74	.70
10	79.2	8.4	74.2	13.4	.832	.85	4.67	.66
11	79.6	10.1	73.5	16.2	.814	.62	5.75	.60
Noon.	79.7	11.5	72.8	18.4	.795	.40	6.62	.56
1	79.8	12.5	72.3	20.0	.783	.24	7.26	.53
2	79.6	13.2	71.7	21.1	.768	.08	.64	.51
3	79.5	13.1	71.6	21.0	.766	.05	.58	.52
4	78.8	12.2	71.5	19.5	.763	.04	6.89	.54
5	78.5	11.1	71.8	17.8	.771	.15	.18	.57
6	78.0	8.6	72.8	13.8	.795	.47	4.67	.65
7	77.6	6.6	73.0	11.2	.801	.57	3.67	.70
8	77.0	5.9	72.9	10.0	.797	.56	.23	.73
9	76.8	4.9	73.4	8.3	.811	.73	2.64	.77
10	76.8	4.6	73.6	7.8	.817	.79	.48	.78
11	76.5	4.0	73.7	6.8	.819	.83	.15	.80

All the Hygrometrical elements are computed by the Greenwich Constants.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1865.

Solar Radiation, Weather, &c.

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches.		
1	140.0	...	S.	Cloudless till 1 P. M. ╲—i & ⌒i afterwards.
2	...	...	*Sunday.*	
3	138.4	...	S. E. & S.	Cloudy till 9 A. M. Scatd. clouds till 6 P. M. ╲—i afterwards drizzled at 4 P. M.
4	141.0	0.73	S. W. & S. E.	╲—i till 9 A. M. ╲—i till 4 P. M. cloudy afterwards, thundering, lightning, raining at 6-7-9 & 10 P. M. & hailstones fell between 5 & 6 P. M.
5	132.0	...	W. & S. & N. W.	╲—i till 1 P. M. cloudless till 7 P. M. ╲—i afterwards.
6	136.0	...	S. & S. E.	Scatd. clouds till 9 A. M. ╲—i till 3 P. M. cloudy afterwards, thundering, lightning & raining between 6 & 7 P. M.
7	137.2	...	S. & S E.	Cloudless till 4 A. M. cloudy till 10 A. M. cloudless afterwards.
8	139.0	...	S. & S. W. & W.	Cloudy till 8 A. M. ⌒i till 8 P. M. cloudless afterwards.
9	...	...	*Sunday.*	
10	136.0	...	S. W. & S.	Cloudy till 9 A. M. cloudless afterwards.
11	141.0	...	S. & S. W.	Flying clouds till 6 A. M. cloudless afterwards.
12	133.5	...	S.	Cloudless till 5 P. M. cloudy afterwards.
13	132.0	...	S. & S W.	╲ till 7 A. M. ⌒i till 3 P. M. ╲—i afterwards.
14	134.5	...	S. & S. W.	Cloudy till 7 A. M. ╲—i till 6 P. M. cloudless afterwards.
15	136.0	...	S. & S. W.	╲—i till noon, cloudless afterwards.
16	...	...	*Sunday.*	
17	136.5	...	S. E. & S.	╲—i till 10 A. M. cloudy afterwards, lightning at 9 & 11 P. M.
18	132.0	0.17	E. & S. & S. E.	Cloudy till 4 A. M. Scatd. clouds afterwards, raining & thundering at 1 P. M.
19	131.0	...	S. & S. W.	Cloudy till 7 A. M. ╲—i & ⌒i till 8 P. M. cloudless afterwards.
20	137.0	...	S. & S. W.	Cloudless till 2 A. M. ╲—i afterwards.
21	132.8	...	S. & S. W.	╲—i till 4 A. M. cloudy till 8 A. M. ╲—i till 4 P. M. cloudless till 7 P. M. cloudy & lightning afterwards.
22	127.5	1.67	S. & S. E.	Scatd. clouds till 1 P. M. cloudy afterwards, raining between midnight & 1 A. M. & from 4 to 7 P. M. thundering & lightning from 5 to 7 P. M.
23	...	1.36	*Sunday.*	

╲i Cirri, —i Strati, ⌒i Cumuli, ╲—i Cirro strati, ⌒—i Cumulo strati, ╲⌒—i Nimbi ╲⌒ i Cirro cumuli.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1865.

Solar Radiation, Weather, &c,

Date.	Max. Solar radiation.	Rain Gauge 5 feet above Ground.	Prevailing direction of the Wind.	General Aspect of the Sky.
	o	Inches		
24	128.9	...	S. E. & S.	Cloudless till 3 A. M. ⌒i & ⁀—i till 7 P. M. cloudless afterwards.
25	135.8	...	S.	Cloudless till 5 A. M. ⌒i & ⁀—i afterwards.
26	131.0	...	S.	⁀—i till 4 A. M. ⁀—i & ⌒i till 2 M. ⌒i till 6 P. M. cloudy afterwards, lightning at 7, 10 & 11 P. M.
27	131.0	...	S.	Cloudy till 11 A. M. ⌒i till 7 P. M. cloudless afterwards, drizzling at 2 A. M. & 1 P. M. lightning at midnight.
28	124.0	...	S. (high.)	⌒i till 8 A. M. ⁀—i afterwards.
29	127.0	0.35	S.	Scatd. clouds till 6 P. M. cloudy afterwards, raining between 9 & 10 P. M. lightning & thundering from 8 to 10 P. M.
30	...	...	*Sunday.*	

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1865.

Monthly Results.

				Inches
Mean height of the Barometer for the month, ..		..	..	29.795
Max. height of the Barometer occurred at 10 A. M. on the 13th,			..	29.985
Min. height of the Barometer occurred at 5 P. M. on the 29th,			..	29.526
Extreme range of the Barometer during the month,		..	..	0.459
Mean of the Daily Max. Pressures,..	..	..	..	29.871
Ditto ditto Min. ditto, ..	..	..	..	29.717
Mean daily range of the Barometer during the month,		..	..	0.154

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				o
Mean Dry Bulb Thermometer for the month, ..		..	..	84.5
Max. Temperature occurred at 3 P. M. on the 4th,		..	..	98.2
Min. Temperature occurred at 6 A. M. on the 5th,		..	..	72.4
Extreme range of the Temperature during the month,		..	..	25.8
Mean of the daily Max. Temperature,	..	..	..	93.5
Ditto ditto Min. ditto, ..	..	..	..	77.8
Mean daily range of the Temperature during the month, ..			..	15.7

Mean Wet Bulb Thermometer for the month, ..		..	..	77.7
Mean Dry Bulb Thermometer above Mean Wet Bulb Thermometer,			..	6.8
Computed Mean Dew-point for the month,	..	..	..	72.9
Mean Dry Bulb Thermometer above computed Mean Dew-point,			..	11.6
				Inches
Mean Elastic force of Vapour for the month, ..		..	..	0.797

				Troy grains
Mean Weight of Vapour for the month,	..	..	..	8.52
Additional Weight of Vapour required for complete saturation,			..	3.83
Mean degree of humidity for the month, complete saturation being unity,				0.69

				Inches
Rained 8 days, Max. fall of rain during 24 hours,		..	..	1.67
Total amount of rain during the month,	..	..	..	4.28
Prevailing direction of the Wind, ..	..	..		S. & S. W.

Abstract of the Results of the Hourly Meteorological Observations taken at the Surveyor General's Office, Calcutta, in the month of April, 1865.

Monthly Results.

Tables showing the number of days on which at a given hour any particular wind blew, together with the number of days on which at the same hour, when any particular wind was blowing, it rained.

Hour.	N.	Rain on.	N. E.	Rain on.	E.	Rain on.	S. E.	Rain on.	S.	Rain on.	S. W.	Rain on.	W.	Rain on.	N. W.	Rain on.	Calm.	Rain on.	Missed.
					No. of days.														
Midnight.					1		3		17		1		1						2
1	1						4	1	18		1		1						
2					2		2		18		2				1	1			
3			1		2		1		18		2		1						
4							2		15		2		2				1		3
5							2		12		4		2		1				4
6			1				3		13		7				1				
7					1		5		11		7				1				
8					2		5		9		7		1		1				
9					1		4		9		9		1		1				
10					1		3		10		7		3		1				
11					1		1		11		8		4						
Noon.							[illegible]		11		5		5		1				
1							6		10		6		3						
2					1		6		7		8		3						
3							9		7		6		3						
4							5	1	11		7	1	1		1	1			
5	1						4	1	16		3		1						
6	2	1					5	2	16		2								
7			1				4	1	18		1		1	1					
8	1				1		3		17	1	2		1						
9					1	1	3		18		1		2						
10					1	1	2		20	1	1								1
11					1		3		20		1								

Meteorological Observations taken at Gangaroowa near Kandy, Ceylon, in the month of January, 1864.

Alt. 1560 ft.; E. Long. 80° 37′, N. Lat. 7° 17′.

All the Instruments have been compared with standards.

The tension of aqueous vapour, dew point and humidity, have been found from the readings of the dry and wet bulb Thermometers by Mr. Glaisher's Hygrometrical tables (Ed. 1863).

The dew is the weight in grains deposited on a square foot of ordinary woollen cloth exposed on a board from 6 P. M. to 6 A. M. or for as many hours as there is no rain.

The rain guage is $4\frac{1}{2}$ feet above the ground.

The ozone cage is hung about 25 feet above the ground.

The direction of the wind given, is that of the lowest current by the vane, and of the currents above this by the direction in which the Nimbi and Cumulo-Strati clouds are moving.

In this column a " calm" signifies that the clouds are apparently motionless: " variable," that the clouds apparently in the same or nearly the same stratum move in no fixed direction, but their parts move as if in vortices, or different masses of them move up from different quarters as if into a vast vortex, this being nearly always the case before thunder storms.

Entries, such as W S W and N N W or $\dfrac{\text{W S W}}{\text{N N W to calm,}}$ signify that the clouds are evidently in strata of different altitudes, that those in the lowest stratum move from W S W; those in the next higher from N N W; those in the next are apparently becalmed, and so on.

The velocity and distance in 24 hours are given by Robinson's Anemometer.

In the column for Lightning and Thunder

L = " Lightning" when the flash is near enough to be visible.

L R = " Lightning Reflection" when the flash is so distant that only its reflection on the clouds or in the air is visible.

" Morn," is 6 A. M., " Even," 6 P. M. and " Night," 12 P. M. and " fore" and " after" are prefixed to these, as ordinarily to " Noon," to denote the 3 previous and 3 following hours.

R H. Barnes.

GANGAROOWA NEAR KANDY, CEYLON.

January, 1864.	A. M. 9.30 Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.	P. M. 3.30 Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.
1	8.0	0	0	0	S	0	8.0	8.7	0	0	0	1.0	0	9.7
2	0.1	0	0	0	0.1	0	0.2	5.7	0	0	0	1.0	0	6.7
3	0.1	0	0	0	0	0	0.1	7.8	0	0	0	0.2	0	8.0
4	0	0	0	0	2.0	0	2.0	0	0	0	0	0	10.0	10.0
5	0	0	9.6	0	0	0.3	9.9	0.3	0	0	0	0	9.2	9.5
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	9.6	0	0	0.2	0	9.8	8.3	0	0.2	0	1.5	0	10.0
15	0.6	0	0.3	0	S	0	0.9	9.4	0	0	0	0.2	0	9.6
16	5.0	0	0	0	0	0	5.0	3.0	0	0	0	0.3	0	3.3
17	9.5	0	0	0	0	0	9.5	5.3	0	0	0	1.7	0	7.0
18	0.1	0	0	0	0	0	0.1	0	0	0	0	S	0	0
19	9.5	0	0	0	0	0	9.5	8.6	0	0	0	0.4	0	9.0
20	10.0	0	0	0	0	0	10.0	10.0	0	0	0	0	0	10.0
21	6.0	0	0	0	0	0	6.0	8.0	0	0	0	0.4	0	8.4
22	0.6	0	0	0	0	0	0.6	1.0	0	0	0	4.4	0	5.4
23	9.8	0	0	0	0.2	0	10.0	7.6	0	2.0	0	0.4	0	10.0
24	8.0	0	0	0	0	0	8.0	6.7	0	0	0	3.3	0	10.0
25	7.3	0	0	0	0.2	0	7.5	0	6.4	0	0	0	3.5	9.9
26	0	9.8	0	0	0	0	9.8	0	9.0	0.1	0	0.8	0	9.9
27	7.5	0	0	0	0.5	0	8.0	4.0	0	0	0	5.0	0	9.0
28	9.0	0	0	0	0	0	9.0	0	10.0	0	0	0	0	10.0
29	0	0	1.0	0	0	0	1.0	7.0	0	0.2	0	S	0	7.2
30	0	0	0	0	0.5	0	0.5	0	0	1.4	0	4.0	0	5.4
31	0	0	0	0	S	0	0	0	0	0	0	S	0	0
	4.0	0.8	0.5	0.0	0.2	0.0	5.5	4.4	1.1	0.2	0.0	1.1	1.0	7.8

GANGAROOWA NEAR KANDY, CEYLON.

P. M. 10.0							Ozone.		9.30 A.M. Direction of wind.		Velocity in feet per Second.
Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.	6 A. M.	6 P. M.	Vane.	Lower Clouds.	
0.2	0	0	0	0	0	0.2	0	0	E N E	Calm ?	3.08
0	0	0	0	0	0	0	0	0	N N E	E N E ?	8.18
0.5	0	0	0	0	0	0.5	0	0	E	None	2.90
1.6	0	0	0	0	3.4	5.0	0	0	Variable	N E by Var.	2.20
0	0	0	0	0	0	0	0	0	W N W	?	0.26
0	0	0	0	0	0	0	0	0	......	......	0
0	0	0	0	0	0	0	0	0	......	......	0
0	0	0	0	0	0	0	0	0	......	......	0
0	0	0	0	0	0	0	0	0	......	......	0
0	0	0	0	0	0	0	0	0	......	......	0
0	0	0	0	0	0	0	0	0	......	......	0
0	0	0	0	0	0	0	0	0	......	......	0
0	0	0	0	0	0	0	0	0	......	......	0
3.0	0	0	0	0	0	3.0	0	0	N E	N E	11.09
0.5	0	0	0	0	0	0.5	0	0	E N E	None	8.27
6.0	0	0	0	0	0	6.0	0	0	N E	None	2.73
5.0	0	0	0	0	0	5.0	0	0	S S E	None	0.70
2.5	0	0	0	0	0	2.5	1	1	E S E	None	2.11
0	0	0	0	0	0	0	2	2	W by S	None	1.14
7.5	0	0	0	0	0	7.5	2	2	N E by E	None	5.81
2.5	0	0	0	0	0	2.5	4	2	E by N	None	7.83
8.0	0	0	0	0	0	8.0	3	2	N E by E	None	10.47
0.3	0	0	0	9.7	0	10.0	2	3	E N E	E N E	9.86
0	0	0	0	9.5	0	9.5	5	1	N E	None	7.30
7.4	0	0	0	0.1	0	7.5	7	2	E N E	N E	4.31
8.5	0	0	0	0.2	0	8.7	4	3	E N E	None	6.42
9.8	0	0	0	0	0	9.8	3	2	E N E	E N E	6.69
0	10.0	0	0	0	0	10.0	3	2	N E by N	None	6.34
0	0	0	0	0	0	0	3	2	N E by E	None	10.21
0	0	0	0	0	0	0	3	1	Variable	E	3.52
0	0	0	0	9.0	0	9.0	3	1	E by N	None	8.45
2.9	0.4	0.0	0.0	1.3	0.2	4.8	3.2	1.8	......	......	5.65

GANGAROOWA NEAR KANDY, CEYLON.

January, 1864.	3.30 P. M. Direction of wind. Vane.	3.30 P. M. Direction of wind. Lower Clouds.	Velocity in feet per Second.	10.0 P. M. Direction of wind. Vane.	10.0 P. M. Direction of wind. Lower Clouds.	Velocity in feet per Second.
1	E	N E	3.52	E N E	None	5.19
2	N W by N	Calm	3.70	N E	None	5.28
3	W by N	Calm	5.28	E N E	None	1.41
4	N	N E	4.49	N N E	?	6.51
5	W N W	Calm	3.26	......	......	0
6	......	......	0	......	......	0
7	......	......	0	......	......	0
8	......	......	0	......	......	0
9	......	......	0	......	......	0
10	......	......	0	......	......	0
11	......	......	0	......	......	0
12	......	......	0	......	......	0
13	......	......	0	......	......	0
14	N W	N E	3.80	N E	None	0
15	W N W	Calm	5.28	N E	None	6.95
16	......	Calm	4.14	Calm	None	0.00
17	N W	S E, N N W & Calm	4.58	N E	None	3.34
18	W N W	None	4.05	N N E	None	2.64
19	W N W	Variable	4.22	N E by E	None	3.87
20	N W by W	None	2.64	E N E	None	4.22
21	E	?	5.28	E by N	None	10.91
22	E N E	Variable	6.69	N E	None	8.54
23	S E by E	Calm	9.59	N E by E	W S W	5.28
24	W	W, Calm	6.42	W	E N E	0.09
25	W N W	S S E (?)	4.58	N E by E	None	5.54
26	E S E	E N E	9.59	N E	None	7.13
27	N W	Variable	2.38	N N E	None	9.94
28	E S E	None	8.71	N E	None	8.62
29	E N E	Calm	7.48	E N E	None	1.85
30	E	Variable	7.48	N E by E	None	10.03
31	E by S	None	8.10	E	?	7.04
	......	......	5.45	......	......	5.45

GANGAROOWA NEAR KANDY, CEYLON.

Distance in Miles in 24 Hours.	Lightning and Thunder.
87.10	
49.24	
48.26	
52.14	
"	
"	
"	
"	
746.30	
"	
"	
"	
"	
"	
35.82	
22.48	
20.41	
36.29	
38.10	
54.41	
95.95	
142.18	
81.44	
44.17	
46 55	
104.87	
90.45	
103.91	
72.78	
59.33	
93.37	
68.57	

GANGAROOWA NEAR KANDY, CEYLON.

January, 1864.	GENERAL REMARKS.
1	Cool to warm, dry and fresh all day.
2	Cool to warm, dry and fresh all day.
3	Fog till 8 A. M.; then fine, warm, dry and fresh.
4	Fine & fresh till noon; heavy nimb and drizzling rain after.
5	Fine till 8 A. M.; then nimb & light rain; cloudy all day & rain in fore even.
6	Fine, dry & fresh all day.
7	
8	Cloudy with nimb; showery & damp all day.
9	Light rain fore and after morn; fine afterwards, squally wind.
10	Cloudy with nimb; damp & showery nearly all day.
11	
12	A little very light rain at 1 P. M.
13	Dull & cloudy with nimbus but no rain; squally wind in after even.
14	Cool to warm, dry and fresh all day.
15	Fog till 8 A. M.; cool to warm, dry and fresh afterwards.
16	Fog till 8 A. M.; cool to warm, dry and fresh afterwards.
17	Cold & damp at morn, mild to very warm, dry and fresh day.
18	Fog till 8 A M.; after, mild to very warm, dry and fresh day.
19	Fog till 8 A. M.; cool to warm, dry and fresh afterwards.
20	Fog till 8 A. M,; cool to warm, dry and fresh afterwards.
21	Cool to warm, dry and fresh all day.
22	The same as above; high wind till noon; moderate after.
23	Cold to warm, fresh; very dry afternoon; squally wind. [after even.
24	Fine, dry and pleasant till noon; close and oppressive afternoon, fore and
25	Damp at morn; very warm & close after 8 A. M. threatening nimb. in afternoon
26	Cool to warm, dry & fresh day; squally wind, at times high. [& fore even.
27	Cool to warm and fresh till noon, then sultry till 8 P. M. and again fresh.
28	Fine, dry & fresh all day; in after even, squally wind, at times high.
29	Cold to hot, dry and fresh all day.
30	Cold to hot, dry and fresh all day.
31	Cold to hot, dry and fresh all day.
	Solar Halo on 15th. Lunar Halos on 14th, 15th and 16th.

Meteorological Observations taken at Gangaroowa near Kandy, Ceylon, in the month of February, 1864.

Alt. 1560 ft.; E. Long. 80° 37′, N. Lat. 7° 17′.

All the Instruments have been compared with standards.

The tension of aqueous vapour, dew point and humidity, have been found from the readings of the dry and wet bulb Thermometers by Mr. Glaisher's Hygrometrical tables (Ed. 1863).

The dew is the weight in grains deposited on a square foot of ordinary woollen cloth exposed on a board from 6 P. M. to 6 A. M. or for as many hours as there is no rain.

The evaporation is given by a Babington's Atmidometer placed under cover so as to be protected from the sun, rain and dew, but freely exposed to the wind.

The rain guage is $4\frac{1}{2}$ feet above the ground.

The ozone cage is hung about 25 feet above the ground.

The direction of the wind given, is that of the lowest current by the vane, and of the currents above this by the direction in which the Nimbi and Cumulo-Strati clouds are moving.

In this column a "calm" signifies that the clouds are apparently motionless: "variable," that the clouds apparently in the same or nearly the same stratum move in no fixed direction, but their parts move as if in vortices, or different masses of them move up from different quarters as if into a vast vortex, this being nearly always the case before thunder storms.

Entries, such as W S W and N N W, or $\frac{\text{W S W}}{\text{N N W to calm,}}$ signify that the clouds are evidently in strata of different altitudes, that those in the lowest stratum move from W S W; those in the next higher from N N W; those in the next are apparently becalmed, and so on.

The velocity and distance in 24 hours are given by Robinson's Anemometer.

In the column for Lightning and Thunder

L = "Lightning" when the flash is near enough to be visible.

L R = "Lightning Reflection" when the flash is so distant that only its reflection on the clouds or in the air is visible.

"Morn," is 6 A. M., "Even," 6 P. M. and "Night," 12 P. M. and "fore" and "after" are prefixed to these, as ordinarily to "Noon," to denote the 3 previous and 3 following hours.

R. H. BARNES.

GANGAROOWA NEAR KANDY, CEYLON.

February, 1864.	Barometer reduced to 32°.			Pressure of Dry Air.			Thermometer.			Dew Point.		
	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0
1	28.433	28.335	28.433	27.907	27.759	27.892	72.5	75.2	70.6	60.4	63.0	61.2
2	.454	.374	.454	.832	.713	.880	73.2	73.9	70.2	65.2	67.0	62.9
3	.443	.335	.451	.772	.660	,,	71.3	73.7	69.6	67.4	67.6	,,
4	.466	.369	.509	.795	.739	.859	73.0	72.8	69.2	67.4	65.6	66.5
5	.509	.386	.511	.911	.796	28.041	73.8	77.0	69.2	64.1	63.7	57.3
6	.507	.389	.488	.909	.769	27.898	71.1	71.5	67.1	64.1	65.1	63.7
7	.480	.359	.469	.891	.822	.919	71.6	76.8	70.7	63.5	61.0	61.7
8	.453	.319	.428	.944	.828	.885	73.6	78.9	71.5	59.5	58.5	61.3
9	.426	.309	.418	.902	.797	.872	75.1	79.9	72.5	60.3	59.7	61.5
10	.421	.293	.399	.954	.748	.815	75.6	80.4	72.2	57.1	61.4	63.4
11	.417	.300	.409	.903	.763	.885	75.0	80.0	71.2	59.8	61.0	60.3
12	.444	.336	.426	.933	.807	.898	74.6	78.3	70.8	59.6	60.6	60.5
13	.432	.293	.387	.912	.764	.801	73.8	80.0	71.8	60.1	60.6	63.5
14	.391	.262	.333	.829	.688	.705	75.2	79.4	71.0	62.3	62.9	65.5
15	.330	.210	.316	.802	.813	.770	73.0	82.3	67.1	60.5	52.6	61.5
16	.333	.219	.326	.923	.730	.665	71.6	80.0	71.4	53.5	58.4	67.0
17	.369	.217	.334	.861	.691	.650	71.8	82.1	73.2	59.3	60.4	68.0
18	.358	.188	.297	.879	.697	.677	72.3	82.2	69.8	57.8	58.5	65.1
19	.325	.183	.306	.769	.676	.633	73.9	82.9	71.7	62.0	59.4	67.5
20	.332	.181	.314	.715	.661	.648	75.0	83.2	71.2	65.0	60.1	67.2
21	.374	.244	.370	.701	.713	.676	77.0	82.6	74.1	67.5	60.7	68.4
22	.408	.276	.391	.834	.773	.831	75.4	82.2	68.5	62.9	59.2	62.2
23	.358	.218	.342	.844	.720	.727	73.2	82.4	69.4	59.8	58.9	64.9
24	.346	.197	.295	.790	.686	.727	73.4	81.8	68.0	62.0	59.6	62.6
25	.344	.214	.335	.786	.650	.722	73.4	82.6	69.8	62.1	62.4	64.8
26	.372	.235	.375	.839	.737	.714	73.2	82.6	74.1	60.8	58.9	67.0
27	.384	.227	.341	.800	.830	.625	75.7	84.6	74.8	63.4	52.6	69.3
28	.335	.178	.312	.757	.722	.637	75.6	85.6	72.0	63.1	56.4	67.6
29	.348	.204	.336	.815	.808	.608	74.8	84.5	75.0	60.8	52.5	69.8
	28.400	28.271	28.383	27.845	27.743	27.774	73.7	80.0	71.0	61.8	60.3	64.4

Gangaroowa near Kandy, Ceylon.

Humidity.			In Sun's Rays at 12 o'clock.	Minimum on the Grass.	Maximum in Air.	Minimum in Air.	Difference.	Mean.	Dew.	Evaporation.	Rain.		
A. M. 9.30	P. M. 3.30	P. M. 10.0									A. M. 9.30	P. M. 10.0	Total.
654	656	719	149.0	56.0	77.0	61.3	15.7	69.2	146	9686	0.000	0.000	0.000
762	791	775	136.4	64.4	76.2	68.0	8.2	72.1	35	8289	0.010	0.029	0.039
871	815	,,	120.2	,,	76.0	67.9	8.1	71.9	56	1346	0.019	0.468	0.487
830	783	911	118.0	67.0	74.9	68.5	6.4	71.7	0	5569	0.026	0.037	0.063
718	638	660	139.9	62.3	77.2	68.0	9.2	72.6	111	8954	0.000	0.000	0.000
780	800	886	137.8	57.1	74.6	62.5	12.1	68.6	156	4019	0.000	0.013	0.013
750	586	728	144.5	56.8	77.1	62.8	14.3	69.9	331	5662	0.000	0.000	0.000
619	497	698	138.5	60.0	78.8	67.2	11.6	73.0	181	8391	0.000	0.000	0.000
597	500	680	138.5	60.7	79.8	68.3	11.5	74.1	158	8644	0.000	0.000	0.000
526	521	742	141.9	56.3	80.5	63.5	17.0	72.0	157	7734	0.000	0.000	0.000
588	521	682	149.2	61.2	80.5	68.8	11.7	74.6	91	5359	0.000	0 000	0.000
592	545	698	139.4	60.0	78.6	68.0	10.6	73.3	84	8341	0.000	0.000	0.000
624	515	745	142.6	54.2	80.2	62.0	18.2	71.1	131	3185	0.000	0.000	0.000
641	566	825	149 1	56.0	80.7	64.0	16.7	72.4	153	5945	0.000	0.000	0.000
652	351	825	144.5	56.3	81.8	63.4	18.4	72.6	228	5915	0.000	0.000	0.000
524	476	855	148.0	49.8	79.9	57.7	22.2	68.8	211	5662	0.000	0.000	0.000
646	480	840	144.3	57.0	81.7	63.4	18.3	72.5	139	5358	0.000	0.000	0.000
598	444	850	141.9	55.3	81.6	61.8	19.8	71.7	234	6724	0.000	0.000	0.000
664	447	863	141.8	54.4	82.0	61.5	20.5	71.8	252	6419	0.000	0.000	0.000
708	455	865	146.0	60.0	82.4	66.8	15.6	74.6	98	5763	0.000	0.000	0.000
726	485	825	148.6	61.3	83.5	67.5	16.0	75.5	141	5288	0.000	0.000	0.000
648	456	805	143.8	59.1	82.2	67.3	14.9	74.7	225	6268	0.000	0.000	0.000
633	447	855	147.8	52.0	82.0	59.7	22 3	70.9	286	6268	0.000	0.000	0.000
676	465	830	144.8	59.3	81.7	65.0	16 7	73.3	182	5985	0.000	0.000	0.000
689	507	840	147.6	53.9	82.2	61.3	20.9	71.8	272	5510	0.000	0.000	0.000
656	444	785	150.2	55.4	82.7	63.0	19.7	72.8	235	6066	0.000	0.000	0.000
652	334	830	149.7	57.5	84.1	64.7	19 4	74.4	196	7330	0.000	0.000	0.000
648	366	865	149.8	58.0	85.2	64.9	20.3	75.1	187	6774	0.000	0.000	0.000
616	334	840	150.6	55.0	84.5	62.2	22.3	73.4	288	7229	0.000	0.000	0.000
665	525	797	142.9	57.7	80.3	64.5	15.8	72.4	4967	6437	0.055	0.547	0.602

GANGAROOWA NEAR KANDY, CEYLON.

February, 1864.	A. M. 9.30 Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.
1	0	0	4.0	0	0.4	0	4.4
2	0	0	0.2	0	5.0	0	5.2
3	0	0	0	0	0	10.0	10.0
4	0	0	3.0	0	0	7.0	10.0
5	0	0	0	0	1.3	0	1.3
6	0	0	0	0	0	9.8	9.8
7	0.2	0	0	0	0	9.0	9.2
8	0.2	0	0	0	0	0	0.2
9	0.4	0	0	0	0	0	0.4
10	0	0	0	0	0	0	0
11	0	0	0	0	0.1	0	0.1
12	0	0	0	0	0.5	0	0.5
13	0.1	0	0	0	0	0	0.1
14	0	0	0	0	0	0	0
15	0.3	0	0	0	0	0	0.3
16	9.0	0	0	0	0	0	9.0
17	3.3	0	0	0	0	0	3.3
18	0.2	0	0	0	0	0	0.2
19	10.0	0	0	0	0	0	10.0
20	0	0	0	0	0.5	0	0.5
21	0	0	0	0	0.7	0	0.7
22	0.9	0	0	0	0.1	0	1.0
23	0.4	0	0	0	0	0	0.4
24	0	0	0	0	1.0	0	1.0
25	0 2	0	0	0	1.5	0	1.7
26	10.0	0	0	0	0	0	10.0
27	8.9	0	0	0	0.1	0	9.0
28	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0
	1.5	0.0	0.3	0.0	0.4	1.2	3.4

February, 1864.	P. M. 3.30 Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.
1	0	0	0	0	10.0	0	10.0
2	0	0	0.2	0	0	9.7	9 9
3	0	0	8.3	0	0	1.7	10.0
4	0	0.6	0.4	0	0	9.0	10.0
5	0	0	0	0	4.0	0	4.0
6	0	0	0	0	0	10.0	10 0
7	0.6	0	0.8	0	6.2	0	7.6
8	5.0	0	0	0	0.5	0	5.5
9	0	0	0	0	4.0	0	4.0
10	0	0	0	0	1.5	0	1.5
11	0.2	0	0	0	1.2	0	1.4
12	0	0	9.0	0	0.3	0	9.3
13	0	0	0	0	0.8	0	0.8
14	0	0	0	0	9.0	0	9.0
15	0.3	0	0	0	0	0	0.4
16	9.5	0	0	0	0	0	9.5
17	0.5	0	0	0	1.0	0	1.5
18	7.4	0	0	0	0.6	0	8.0
19	4.6	0	0	0	0.7	0	5.3
20	8.7	0	0	0	0.3	0	9.0
21	0	0	0	0	0.6	0	0.6
22	6.6	0	0	0	0.4	0	7.0
23	3.3	0	0	0	0.1	0	3.4
24	1.5	0	0	0	0.2	0	1.7
25	1.0	0	0	0	3.3	0	4.3
26	0	0	0	0	0	0	0
27	0.2	0	0	0	0.2	0	0.4
28	0	0	0	0	0.7	0	0.7
29	0.1	0	0	0	0.3	0	0.4
	1.8	0.0	0.7	0.0	1.6	1.1	5.2

Gangaroowa near Kandy, Ceylon.

P. M. 10.0							Ozone.		9.30 A.M. Direction of wind.		Velocity in feet per Second.
Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.	6 A. M.	6 P. M.	Vane.	Lower Clouds.	
0	0	0	0	9.8	0	9.8	2	2	E by S	W	7.85
0	0	0	0	2.0	0	2.0	3	2	E	E N E	5.35
0	0	0	0	0	10.0	10.0	3.5	8	N E	E N E	0.22
0	0	0	0	0	10.0	10.0	9	3	E	E	4.86
0	0	0	0	0	0	0	5	2	E by N	E by N	14.91
0	0	0	0	1.0	0	1.0	2	3	N	N E by E	3.52
0	0	0	0	0.2	0	0.2	1.0	2	N E	E by N	4.40
0	0	0	0	0	0	0	1	1	E	None	11.79
0	0	0	0	0	0	0	1	2	E N E	E	8.45
0	0	0	0	0.2	0	0.2	4	2	N E	None	9.50
0	0	0	0	2.0	0	2.0	2	2	E by N	N E	11.18
0.2	0	0	0	0	0	0.2	2	1	E	E	17.69
0	0	0	0	3.3	0	3.3	3	1	N E	None	14.52
3.5	0	3.5	0	0	0	7.0	3	0	E N E	None	8.01
10.0	0	0	0	0	0	10.0	0	0	S E	None	2.64
0	0	0	0	10.0	0	10.0	0	0	W S W	None	1.94
0	0	0	0	9.0	0	9.0	0	0	N	None	1.58
0	0	0	0	4.0	0	4.0	0	0	Variable	None	1.32
0	0	0	0	8.5	0	8.5	0	0	S W	None	3.52
0	0	0	0	9.0	0	9.0	0	1	S W by S	Calm	3.08
0	0	0	0	9.2	0	9.2	1	1	N N W	Calm	2.38
9.5	0	0	0	0	0	9.5	2	1	W by N	Calm	3.52
0.2	0	0	0	0	0.5	0.7	0	0	Variable	None	2.46
0.3	0	0	0	0	0	0.3	0	0.5	Variable	Calm	1.58
4.0	0	0	0	0	0	4.0	0	0.5	W S W	Variable	4.05
0.4	0	0	0	9.6	0	10.0	0	0	N W by N	None	1.41
0	0	0	0	9.3	0	9.3	0	0	S S E	Calm	1.85
0	0	0	0	0	10.0	10.0	0	0	S W	None	2.82
0	0	0	0	0	8.0	8.0	0	0	N W	None	2.11
1.0	0.0	0.1	0.0	3.0	1.3	5.4	1.8	1.2	......	......	5.46

Gangaroowa near Kandy, Ceylon.

February, 1864.	3.30 P. M. Direction of wind.		Velocity in feet per Second.	10.0 P. M. Direction of wind.		Velocity in feet per Second.
	Vane.	Lower Clouds.		Vane.	Lower Clouds.	
1	E N E	Calm	5.14	N N E	Too dark	4.27
2	E	N E	2.43	Variable	Too dark	0.39
3	E by N	E by N	12.32	E by N	Too dark	6.16
4	E by N	E	16.63	N E by E	Too dark	8.62
5	E by S	E N E	9.94	E	None	16.98
6	E	E N E	1.41	W N W	Too dark	2.82
7	E by N	E N E	17.60	E by N	Too dark	7.66
8	E by S	Calm	14.52	E N E	None	11.00
9	E N E	Variable	3.87	E N E	None	12.85
10	E N E	E N E Calm	7.57	E N E	Too dark	9.50
11	E	Calm ?	14.26	N E	Calm	8.10
12	E by S	N N E	18.39	E N E	None	17.51
13	E N E	Calm	9.59	E by N	Calm	11.62
14	W N W	Calm	6.51	S W by W	None	1.06
15	Variable	None	2.73	Calm	None	0.00
16	N W	None	5.98	N	Calm	1.41
17	Variable	Calm	4.49	N W	Calm	1.06
18	W S W	Calm	8.27	N N W	Variable	2.38
19	W	Calm	5.81	S W by S	Calm	0.18
20	W	Calm	8.18	W N W	N	2.99
21	Variable	Calm	4.22	W N W	E N E	0.62
22	N	Calm	4.22	Calm	None	0.00
23	W N W	N N E ?	5.98	N N W	E by S	3.08
24	W S W	Calm	5.90	N N W	None	2.99
25	W S W	Variable	5.19	N N W	None	2.20
26	W N W	Calm	5.90	N N W	Calm	0.44
27	W N W	Calm	6.60	W	Calm	0.88
28	W N W	Calm	8.45	N W	?	2.64
29	E	Calm	10.30	N by E	Variable	1.14
	......	......	8.01	......	......	4.85

GANGAROOWA NEAR KANDY, CEYLON.

Distance in Miles in 24 Hours.	Lightning and Thunder.
64.55	
82.19	L R to S S W in after even.
79.31	
125.98	
219.21	
64.96	
121.12	
164.14	
173.00	
177.13	L to S in after even.
203.20	
201.11	
149 41	
102.09	
37.33	
41.39	
43.24	
58.59	
60.72	
47.45	L R to S in after even.
43,58	L R to W in after even.
53.90	L to S S W at even.
43.33	
46.53	
46.31	
41.80	
48.06	
48.31	L to S W *ward* at even.
56.09	L R to S W in after night.
91.17	

GANGAROOWA NEAR KANDY, CEYLON.

February, 1864.	GENERAL REMARKS.
1	Fine, dry and pleasant day.
2	In fore and afternoon heavy nimbi from N E; a little light rain.
3	Nimbi from N E & E nearly all day; light showers throughout the day.
4	Nimbi from E all day; a little very light rain.
5	High wind at night, more mod. in the day, which fine, dry and fresh.
6	Heavy nimbi from N E & E; a few light showers in afternoon.
7	Fine, mild to warm, dry and fresh day.
8	Cool at morn, warm to hot & very dry day.
9	Mild to hot and dry; sultry & oppressive in afternoon.
10	Cool and fresh at morn, warm to very hot and dry day.
11	Squally wind at times high; mild to hot and very dry.
12	Squally wind at times high; mild to hot and very dry.
13	Cool and fresh at morn, mild to hot and dry day. [& till about 8 P. M.
14	Cool at morn & after 10 P. M., hot & dry day; close & oppressive afternoon
15	Cool at morn & after 10 P. M.; fog at morn; very hot & dry day.
16	Cold & fresh at morn; hot & dry day, sultry & oppressive after 12.
17	Cool to mild & fresh till 10 A. M.; hot & very dry fore & afternoon, sultry &
	oppressive after 6 A. M. [even.
18	Cool at morn; & after 10 P. M.; hot and very dry fore & afternoon & fore
19	Cool to mild to 10 A. M.; hot & very dry till 6 P. M.; close & sultry after.
20	Cool to mild to 10 A. M.; hot & very dry till 6 P. M.; close & sultry after.
21	Cool to mild to 10 A. M.; hot & very dry till 6 P. M.; pleasant after even.
22	Cool to mild to 10 A. M.; hot & very dry till 6 P. M.; cool & fresh after 8 P. M.
23	Cold & damp at morn; fog till nearly 8 A. M.; hot & very dry till 6 P. M. then
24	Cool at morn & after 10 P. M.; warm to very hot & dry till 6 P. M. [pleasant.
25	The same as 24th but sultry & oppressive at even and till 8 P. M.
26	The same as 25th; fog at morn & till 7 A. M.
27	Cool at morn; hot & very dry but fresh till 9 P. M. then close & sultry.
28	The same as 27th, but sultry in early part of after even; pleasant later.
29	The same as 28th, but sultry & oppressive all after even.
	Solar Halos on 8th, 16th & 27th. Lunar Halos on 15th and 22nd.

Meteorological Observations taken at Gangaroowa near Kandy, Ceylon, in the month of March, 1864.

Alt. 1560 ft.; E. Long. 80° 37′, N. Lat. 7° 17′.

All the Instruments have been compared with standards.

The tension of aqueous vapour, dew point and humidity, have been found from the readings of the dry and wet bulb Thermometers by Mr. Glaisher's Hygrometrical tables (Ed. 1863).

The dew is the weight in grains deposited on a square foot of ordinary woollen cloth exposed on a board from 6 P. M. to 6 A. M. or for as many hours as there is no rain.

The evaporation is given by a Babington's Atmidometer placed under cover so as to be protected from the sun, rain and dew, but freely exposed to the wind.

The rain guage is $4\frac{1}{2}$ feet above the ground.

The ozone cage is hung about 25 feet above the ground.

The direction of the wind given, is that of the lowest current, by the vane; and of the currents above this, by the direction in which the Nimbi and Cumulo-Strati clouds are moving.

In this column a "calm" signifies that the clouds are apparently motionless: "variable," that the clouds apparently in the same or nearly the same stratum move in no fixed direction, but their parts move as if in vortices, or different masses of them move up from different quarters as if into a vast vortex, this being nearly always the case before thunder storms.

Entries, such as $\frac{\text{W S W}}{\text{N N W}}$, or $\frac{\text{W S W}}{\text{N N W}\ \overline{\text{calm}}}$, signify that the clouds are evidently in strata of different altitudes, that those in the lowest stratum move from W S W; those in the next higher from N N W; those in the next are apparently becalmed, and so on.

The velocity and distance in 24 hours are given by Robinson's Anemometer.

In the column for Lightning and Thunder—

L = "Lightning," when the flash is near enough to be visible.

L R = "Lightning Reflection," when the flash is so distant that only its reflection on the clouds or in the air is visible.

"Morn," is 6 A. M., "Even," 6 P. M. and "Night," 12 P. M. and "fore" and "after" are prefixed to these, as ordinarily to "Noon," to denote the 3 previous and 3 following hours.

R. H. BARNES.

Gangaroowa near Kandy, Ceylon.

March, 1864.	Barometer reduced to 32°.			Pressure of Dry Air.			Thermometer.			Dew Point.		
	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0
1	28.385	28.244	28.386	27.815	27.788	27.734	77.0	82.9	73.9	62.7	56.4	66.6
2	.390	.267	.400	.849	.780	.684	75.8	83.1	73.5	61.2	58.3	69.3
3	.395	.260	.374	.805	.706	750	76.7	83.1	69.3	63.7	61.9	65.3
4	.408	.279	.406	.962	.785	.888	75.0	81.5	73.7	55.8	58.7	60.0
5	.444	.297	.404	.901	.799	.816	75.7	81.0	73.0	61.3	58.9	63.6
6	.446	.329	.420	.816	.677	.798	74.4	73.9	71.6	65.6	66.6	65.2
7	.416	.290	.387	.824	.708	.789	77.4	78.2	73.8	63.8	63.3	64.1
8	.403	.271	.384	.802	.630	.745	78.0	80.7	73.7	64.2	66.1	66.0
9	.385	.278	.406	.944	.756	.740	78.5	82.4	72.6	55.5	60.2	67.2
10	.433	.308	.438	.930	.779	.777	77.8	83.1	73.4	59.2	60.6	67.0
11	.448	.297	.381	.882	.875	.825	76.3	81.4	71.5	62.5	54.3	62.0
12	.379	.270	.379	.857	.702	.764	77.3	82.5	74.5	60.2	62.6	64.9
13	.394	.278	.375	.802	.700	.742	78.2	80.2	73.7	63.8	63.1	65.7
14	.363	.235	.385	.795	.519	.672	78.4	77.3	71.5	62.6	69.3	69.2
15	.370	.232	.384	.737	.599	.653	76.3	82.8	72.0	65.7	65.7	69.9
16	.380	.260	.416	.784	.694	.667	76.0	82.5	75.2	64.0	62.5	70.6
17	.427	.284	.411	.803	.724	.705	77.0	83.7	74.1	65.3	62.2	68.9
18	.427	.267	.396	.790	.666	.660	78.1	83.3	74.5	65.9	64.2	70.1
19	.382	.269	.391	.802	.645	.653	77.8	80.6	75.2	63.2	65.3	70.2
20	.403	.265	.401	.781	.935	.688	76.5	86.0	76.0	65.2	47.6	69.2
21	.391	.263	.396	.922	.878	.678	77.8	85.6	73.1	57.2	51.8	69.4
22	.385	.262	.371	.839	.821	.648	79.1	85.7	74.1	61.5	55.5	69.6
23	.392	.244	.359	.830	.795	.660	77.9	85.3	74.0	62.3	56.0	68.6
24	.353	.247	.375	.941	.835	.731	79.2	85.8	73.2	53.6	53.6	66.2
25	.375	.269	.390	.838	.792	.664	78.4	86.0	73.8	61.0	57.7	69.7
26	.417	.276	.378	.843	.769	.732	80.5	86.6	76.9	62.9	59.4	66.3
27	.391	.261	.385	.845	.784	.667	80.0	86.7	75.6	61.5	57.7	69.4
28	.381	.270	.367	.785	.557	.646	79.5	76.5	72.2	64.0	69.2	69.5
29	.397	.263	.378	.769	.662	.629	77.4	83.2	74.3	65.5	64.2	70.6
30	.414	.298	.404	.832	.767	.710	77.8	84.7	75.1	63.3	60.7	68.4
31	.395	.279	.400	.805	.670	.664	78.0	84.3	76.2	63.7	64.6	70.1
	28.399	28.273	28.391	27.836	27.735	27.715	77.2	82.6	73.7	62.2	60.6	67.5

GANGAROOWA NEAR KANDY, CEYLON.

Humidity. A. M. 9.30	Humidity. P. M. 3.30	Humidity. P. M. 10.0	In Sun's Rays at 12 o'clock.	Minimum on the Grass.	Maximum in Air.	Minimum in Air.	Difference.	Mean.	Dew in Grs. per sqr. ft.	Evaporation in Grs per sqr. ft.	Rain. A. M. 9.30	Rain. P. M. 10.0	Rain. Total.
614	402	783	151.0	57.2	82.3	64.8	17.5	73.5	221	6168	0.000	0.006	0.006
606	424	870	150.0	57.1	82.0	63.5	18.5	72.7	202	5894	0.000	0.000	0.000
646	490	871	153.6	59.1	82.6	66.6	16.0	74.6	94	5915	0.000	0.000	0.000
514	457	625	141.0	50.6	81.7	58.0	23.7	69.9	404	8038	0.000	0.000	0.000
609	464	724	135.2	58.2	81.4	65.7	15.7	73.6	137	8239	0.000	0.000	0.000
738	783	800	134.0	66.2	78.8	69.7	9.1	74.2	34	4802	0.050	0.138	0.188
632	600	718	145.2	65.9	82.8	70.2	12.6	76.5	110	6672	0.000	0.000	0.000
626	609	775	159.0	63.5	83.4	69.8	13.6	76.6	96	6622	0.000	0.018	0.018
452	471	835	150.2	60.0	83.1	67.2	15.9	75.2	124	8391	0.000	0.000	0.000
530	466	806	155.2	59.3	83.4	66.2	17.2	74.8	103	6673	0.000	0.000	0.000
628	386	715	150.0	58.2	81.7	65.4	16.3	73.5	184	7229	0.000	0.000	0.000
557	513	720	146.3	53.4	82.8	59.9	22.9	71.4	273	7178	0.000	0.000	0.000
612	554	766	143.2	61.4	82.1	68.0	14.1	75.0	96	6925	0.000	0.008	0.008
573	762	926	159.2	60.0	83.2	66.4	16.8	74.8	173	5005	0.000	0.176	0.176
702	561	930	150.4	65.0	82.8	67.8	15.0	75.3	178	3913	0.000	0.075	0.075
670	510	855	150.5	60.3	83.0	65.5	17.5	74.2	314	5894	0.000	0.000	0.000
674	481	840	155.1	60.1	83.4	66.3	17.1	74.9	278	5561	0.000	0.000	0.000
663	525	865	150.7	66.8	83.6	70.9	12.7	77.2	127	5156	0.000	0.002	0.002
612	592	845	153.9	63.6	84.9	68.7	16.2	76.8	67	5085	0.000	0.000	0.000
686	267	790	151.9	60.1	86.0	65.2	20.8	75.6	163	7613	0.000	0.000	0.000
533	315	885	150.0	62.1	85.9	65.1	20.8	75.5	156	8563	0.000	0.000	0.000
548	354	860	148.8	59.8	86.3	66.7	19.6	76.5	225	9201	0.000	0.000	0.000
591	366	835	146.9	59.9	86.2	64.8	21.4	75.5	244	7835	0.000	0.000	0.000
414	330	792	148.6	55.2	86.4	62.2	24.2	74.3	307	1060	0.000	0.000	0.000
559	376	870	145.2	56.3	86.2	63.2	23.0	74.7	255	7[illegible]7	0.000	0.000	0.000
545	391	702	146.5	58.8	86.7	65.6	21.1	76.2	288	9[illegible]6	0.000	0.000	0.000
530	368	810	145.0	58.5	86.9	65.3	21.6	76.1	202	8341	0.000	0.000	0.000
587	779	920	147.8	62.8	83.5	68.2	15.3	75.9	202	3973	0.000	0.114	0.114
670	528	885	154.1	61.4	85.4	65.7	19.7	75.5	273	4691	0.000	0.000	0.000
616	442	796	151.1	61.2	86.3	66.7	19.6	76.5	242	6399	0.000	0.000	0.000
614	513	811	146.9	59.9	86.5	65.8	20.7	76.2	268	5864	0.000	0.000	0.000
598	487	814	148.9	60.1	83.9	66.0	17.9	74.9	6040	6763	0.050	0.537	0.587

Gangaroowa near Kandy, Ceylon.

March, 1864.	A. M. 9.30 Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.	P. M. 3.30 Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.
1	0	0	0.2	0	1.2	0	1.4	1.2	0	0	0	6.6	0	7 8
2	6.7	0	0	0	0	0	6.7	0 1	0	0	0	9.5	0	9.6
3	9.0	0	0	0	0	0	9.0	3.8	0	0	0	6.0	0	9.8
4	10.0	0	0	0	0	0	10.0	8.5	0	0	0	0.3	0	8.8
5	8.8	0	0	0	1.2	0	10.0	9.8	0	0	0	0.2	0	10.0
6	0	0	0.1	0	0	9.9	10.0	0	2.7	6.0	0	0	1.2	9.9
7	0	0	0.6	0	3.0	0	3.6	0	7.7	2.0	0	0	0.3	10.0
8	0.1	0	0	0	0.6	0	0 7	0	4.0	0	0	0	5.8	9.8
9	0.2	0	0	0	0	0	0.2	7.2	1.2	0	0	1.2	0	9.6
10	1.1	0	0	0	0.1	0	1.2	0	0	0	0	3.5	0	3.5
11	0.3	0	0	0	2 2	0	2.5	5.4	0	0	0	0.6	0	6.0
12	0.1	0	0	0	0.1	0	0.2	1.0	0	0	0.1	3.3	0	4.4
13	0	0	0	0	4.0	0	4.0	0	5.4	2.2	0.4	1 0	0	9.0
14	2.0	0	1.4	0	0.3	0	3.7	0	0.7	0.3	0	0	7.8	8.8
15	0.1	0	0	0	0.2	0	0.3	0	0	0	0.2	7.3	0	7.5
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	1.0	0	1.0	0.7	0	0	0	6.0	0	6.7
18	0	0	0	0	4.0	0	4.0	0	0	0	0	0	9.3	9.3
19	0	0	0	0	0.1	0	0.1	0	3.0	0	0	5.0	0	8.0
20	0	0	0	0	0	0	0.0	0	0	0	0	0.5	0	0.5
21	0	0	0	0	0	0	0.0	0	0	0	0	0.4	0	0.4
22	0.1	0	0	0	0	0	0.1	2.5	0	0	0	0.8	0	3.3
23	1.2	0	0	0	0	0	1.2	0	0	0	0	0.6	0	0.6
24	0.2	0	0	0	0	0	0.2	0	0	0	0	0.4	0	0.4
25	0	0	0	0	0	0	0.0	0	0	0	0	1.0	0	1.0
26	0	0	0	0	0.5	0	0.5	0	0	0	0	1.5	0	1.5
27	0	0	0	0	0.3	0	0.3	4.7	0	0	0	1.3	0	6.0
28	1.3	0	0.1	0	5.	0	6.4	0	1.3	0	0	0	8.7	10.0
29	0	0	0.5	0.1	0.3	0	0.9	0.3	0.8	0	0.1	8.0	0	9.2
30	0.5	0	0	0	0.3	0	0.8	0	0	0	0.1	7.4	0	7.5
31	1.5	0	0	0	0	0	1.5	0	0	0	0.4	0.7	5.0	6.1
	1.5	0.0	0.1	0.0	0.8	0.3	2.7	1.5	0.9	0.4	0.0	2.4	1.3	6.5

GANGAROOWA NEAR KANDY, CEYLON.

P. M. 10.0							Ozone.		9.30 A.M. Direction of wind.		Velocity in feet per Second.
Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.	6 A. M.	6 P. M.	Vane.	Lower Clouds.	
0	0	0	0	0	9.9	9.9	0	0.5	E by	E N E	3 78
0	0	0	0	0	9.7	9.7	0	0	S W	None	2.29
0	0	0	0	0	0	0.0	0	0.5	N E	None	8.89
5.0	0	0	0	0	0	5.0	0	0.5	E S E	None	14.43
9.7	0	0	0	0.3	0	10.0	2	1	E N E	E N E	18.92
0	0	0	0	0	0	0	3	3	E	E	8.89
0	0	0	0	0	9.4	9.4	2	1	E	E by S	9.86
0	0	2.0	0	6.0	0	8.0	2	1.5	E N E	E	13.64
0	0	0	0	1.3	0	1.3	3	0.5	N E	None	13.29
0	0	0	0	0	7.0	7.0	1	0.5	E N E	Calm	11.97
0	0	0	0	0	0	0.0	0	1	E by N	Calm	5.98
0	0	0	0	0.2	0	0.2	2	1	E S E	?	15.93
1.9	0	7.0	0	0.1	0	9.0	3	1	E S E	E by S	9 94
5.0	0	0	0	0	5.0	10.0	0	1	E	E by	10.65
0	0	0	0	9.0	0	9.0	0	0.5	W by	?	2.29
0	0	0	0	0	9.6	9.6	0	0	......	......	0
0	0	0	0	0	10.0	10.0	0	0.5	S W	Calm	0.88
0	0	0	0	0	9.6	9.6	.0	1	W N W	Variable	4.14
0	3.0	0	0	2.0	0	5.0	0	0.5	S S W	Calm	2.20
0	0	0	0	9.0	0	9.0	0	0.5	N by	None	2.82
0	0	0	0	8.0	0	8.0	0	0.5	E N E	None	10.91
0	10.0	0	0	0	0	10.0	0	0	N E by E	None	10.38
0.3	0	0.6	0	7.1	0	8.0	0	0	Variable	None	2.11
0	0	0	0	0	0	0.0	0	0.5	E S E	None	14.87
0	0	0	0	1.0	0	1.0	1	0.5	N E	None	7.13
0	0	0	0	1.0	0	1.0	1	1	E N E	E by S	14.87
6.7	0	0	0	3.3	0	10.0	3	0.5	E by	E	3.08
2.0	0	0	0	2.0	0	4.0	0	1.5	N E by	Variable	6.60
0	0	0	0	1.0	0	1.0	0	0	N E	Calm	8.80
0	0	0	0	0.1	0	0.1	0	0.5	S by W	Variable	3 61
0	0	0	0	2.5	0	2.5	0	0.5	S S W	None	1.67
1.0	0.4	0.3	0.0	1.8	2.4	5.9	0.7	0.7	......	......	8.16

Gangaroowa near Kandy, Ceylon.

March, 1864.	3.30 P. M. Direction of wind. Vane.	3.30 P. M. Direction of wind. Lower Clouds.	Velocity in feet per Second.	10.0 P. M. Direction of wind. Vane.	10.0 P. M. Direction of wind. Lower Clouds.	Velocity in feet per Second.
1	Variable	Variable	6.60	N W by	Calm	1.76
2	N E	Variable	7.74	Calm	Too dark	0.00
3	N W by	Variable	3.87	W by S	None	0.35
4	E	E	14.17	E by N	None	8.45
5	E	E by S	13.73	E	Too dark	11.88
6	E by S	E	13.38	E S E	E	8.62
7	E	E	11.35	E by N	Too dark	11.62
8	N E	E by N calm	19.89	E S E	Too dark	6.78
9	E by N	Calm	15.40	E N E by	Too dark	0.53
10	N E by N	W N W calm	686	N W by W	Calm	0.00
11	E by N	Calm	13.20	S S W	None	0.00
12	E N E	Calm	12.91	E S E by	Calm	1.94
13	E by N	Calm	23.67	E by	None	1.23
14	N W by W	Variable	8 80	N	?	2.82
15	N N W	E N E	5.37	W by	Calm	0.09
16	......	......	0	W	Variable	0.70
17	W N W	Variable	3.52	N W	Variable	0.09
18	W by S	Variable	8.98	N W	N W by	0.70
19	W S W	E	1 76	W	Calm	0.09
20	E by N	Calm	13.20	W by S	Variable	2.46
21	N E by	Calm	9.24	Calm	Variable	0.00
22	E	Calm	8.27	S W by	None	0.00
23	N E by E	E by calm	11.00	Variable	E S E	1.32
24	E	Calm	14.08	N N W	None	3.87
25	E by N	Calm	17.07	Calm	E by S	0.00
26	E by N	E	14.78	E	E	6.25
27	E by	Variable	8.80	W N W by	Calm	1.67
28	S S W	Variable	9.50	S	Calm	3.17
29	N N E	Variable	2.20	Calm	?	0.00
30	N W by N	Variable	1.58	W N W	None	2.64
31	W S W	Variable Calm	6.07	N W	?	2.29
	......	......	10.23	......	......	2.62

GANGAROOWA NEAR KANDY, CEYLON.

Distance in Miles in 24 Hours.	Lightning and Thunder.
48 20	
49.57	Th. in fore even & at even to S W Faint L R.
51.19	
127.95	
166.97	
169.51	
167.06	In afternoon Th. to S Wward.
128.66	In fore even Th. to N E. In after even L R to S.
140.50	Th. in fore even to S W and in after even.
75.96	In after even L R to N N N E & S W.
66.02	
107.73	
157.30	In after even L R to N W & S W.
66.79	In fore even Th. & in after even L R to N W.
41.76	Th. in afternoon & fore even.
58.81	
44.19	
42.69	In fore even Th. to S W.
42.21	In afternoon Th. to S Wward.
66.78	
77.53	
97.22	At even & some time after L & L R to S W.
80.65	In after even L R to S W & W S W.
108.82	
93.00	
157.16	
108.80	In after even L & L R to W & W N W & W S W, S S W. Th. very distant.
46.94	In afternoon Th. In after even L R to E S E, W S W, S by W.
52.34	In fore even L & Th. to N W at 10 P. M. L R to S W.
46.11	In after even L R to S.
48.67	Th. in afternoon & fore even.
88.29	

Gangaroowa near Kandy, Ceylon.

March, 1864.	GENERAL REMARKS.
1	Cool fresh morn; hot & dry fore & afternoon; warm & very sultry after, with heavy clouds, some light rain.
2	The same as above, clouds gather earlier: but no rain.
3	Fine, warm to very hot day. Cool & fresh after even.
4	Fog at morn: cold & fresh, dry, warm to hot day. Mild after even.
5	Cool & dry at morn: as above for the rest of the day.
6	Mild to warm & damp, light showers throughout the day.
7	Fine dry & fresh till noon, in afternoon heavy clouds & storm to S W; in after [even some very light rain.
8	The same as above, but light rain in fore even, & fine after 8 P. M.
9	Cool & fresh at morn: fine, hot & dry till fore even, when heavy clouds gathered but only a few drops of rain.
10	Fine, warm to hot & dry day; threatening Nim at even & after, but no rain.
11	Warm to hot & very dry day, in later after even mild to cool & fresh.
12	Cool fresh morn; hot & very dry day; heavy clouds fore & after even till 9 P. M. when clear, cool & fresh. [even.
13	Mild to cool morn; hot & dry till even, heavy clouds & light shower in fore
14	Mild at morn; fine, hot & dry till 2.45 P. M. after warm & muggy, some light rain.
15	Very damp at morn; hot, dry oppressive day, heavy Nim. gather & break up; rain in fore even.
16	Cool morn fine, hot dry day, afternoon heavy clouds gather & break up.
17	Cool at morn, fine, warm to hot & dry day, close & muggy at 10.0 P. M.
18	Mild to hot & oppressive day, in fore & after even, heavy Nim. [here.
19	Fine & pleasant morn; hot & sultry day; heavy clouds in afternoon, no rain
20	Cool morn; clear, hot & very dry fore & afternoon, sultry after even, sky over-
21	The same as the 20th. [cast with Cum. Stratus.
22	The same as above, but in after even sky covered by Electric Cirro-stratus; squally wind in fore & afternoon. [Cum. Str. & Cir. Cum.
23	The same as above, in after even very sultry & oppressive, sky overcast with
24	The same as above till even, but after even fine, clear & fresh. [& afternoon.
25	The same as above till even, after even fine & clear but sultry, squally wind fore
26	The same as above till even, after even fine, dry & pleasant; squally wind from 9 A. M. till even. [out rain, very sultry fore & after even.
27	The same till 4 P. M. then heavy Nim. gathered over the sky, but cleared with-
28	Hot & oppressive, dry till 2 P. M, then damp heavy clouds gathered in forenoon and smart showers at 4 P. M.
29	Fog at morn; hot, dry very oppressive day; heavy Nim. gathered in afternoon & covered the sky fore & after even, but no rain.
30	Cool at morn; warm to hot dry & sultry all day, clear till 2 P. M. when heavy Nim. gathered; a few drops rain till [afternoon, but no rain.
31	Cool at morn; hot, dry day, sultry at even & after, heavy clouds gathered in
	Solar Halo 5th, 6th, 11th, 31st. Lunar Halo 22nd.

Meteorological Observations taken at Gangaroowa near Kandy, Ceylon, in the month of April, 1864.

Alt. 1560 ft.; E. Long. 80° 37′, N. Lat. 7° 17′.

All the Instruments have been compared with standards.

The tension of aqueous vapour, dew point and humidity, have been found from the readings of the dry and wet bulb Thermometers by Mr. Glaisher's Hygrometrical tables (Ed. 1863).

The dew is the weight in grains deposited on a square foot of ordinary woollen cloth exposed on a board from 6 P. M. to 6 A. M. or for as many hours as there is no rain.

The evaporation is given by a Babington's Atmidometer placed under cover, so as to be protected from the sun, rain and dew, but freely exposed to the wind.

The ozone cage is hung about 25 feet above the ground.

The direction of the wind given, is that of the lowest current, by the vane; and of the currents above this, by the direction in which the Nimbi and Cumulo-Strati clouds are moving.

In this column a "calm" signifies that the clouds are apparently motionless: "variable," that the clouds apparently in the same or nearly the same stratum move in no fixed direction, but their parts move as if in vortices, or different masses of them move up from different quarters as if into a vast vortex, this being nearly always the case before thunder storms.

Entries, such as $\frac{\text{W S W}}{\text{N N W}}$, or $\frac{\text{W S W}}{\text{N N W}\;\overline{\text{calm,}}}$ signify that the clouds are evidently in strata of different altitudes, that those in the lowest stratum move from W S W; those in the next higher from N N W; those in the next are apparently becalmed, and so on.

The velocity and distance in 24 hours are given by Robinson's Anemometer.

In the column for Lightning and Thunder—

L = "Lightning," when the flash is near enough to be visible.

L R = "Lightning Reflection," when the flash is so distant that only its reflection on the clouds or in the air is visible.

"Morn," is 6 A. M., "Even," 6 P. M. and "Night," 12 P. M. and "fore" and "after" are prefixed to these, as ordinarily to "Noon," to denote the 3 previous and 3 following hours.

R. H. BARNES.

Gangaroowa near Kandy, Ceylon.

April, 1864.	Barometer reduced to 32°.			Pressure of Dry Air.			Thermometer.			Dew Point.		
	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0	A. M. 9.30	P. M. 3.30	P. M. 10.0
1	28.422	28.256	28.396	27.805	27.666	27.704	78.9	84.6	74.9	65.0	63.7	68.3
2	.410	.272	.395	.790	.884	.694	78.5	85.9	73.0	65.1	52 0	68.7
3	.429	.284	.385	.881	.890	701	78.5	85.4	73.5	61.6	52.4	68.0
4	.396	.276	.384	.770	.675	.769	77.3	83.2	75.2	65.4	64.2	64.9
5	.379	.244	.348	.766	.662	.612	78.2	85.9	73.5	64.8	63.3	70.1
6	.353	.251	.336	.673	.564	.616	79.3	71.9	72.0	67.8	68.1	69.4
7	.338	.207	.322	.637	.520	.596	76.7	80.7	72.0	68.7	68.1	69.7
8	.305	.171	.287	.664	.532	.527	77.5	83.7	73.2	66.1	66.0	71.0
9	.301	.158	.280	.628	.553	.481	77.4	86.4	76.1	67.5	64.4	72.5
10	.307	.221	.320	.615	.562	.616	80.1	81.3	72.3	68.3	66.9	68.8
11	.329	.206	.360	.651	.514	.596	79.0	82.2	73.1	67.7	68.3	71.2
12	.336	.189	.344	.642	.445	.590	77.4	82.4	72.5	68 4	70.4	70.8
13	.343	.205	.321	.610	.544	.603	78.3	82.3	72.0	70.0	67.0	69.4
14	.254	.153	.280	.604	.548	.534	77.2	84.3	73.6	66.5	64.4	70.5
15	.280	.153	.274	.593	.489	.530	77.4	84.7	77.0	68.1	67.1	70.4
16	.299	.171	.271	.543	.378	.517	78.8	79.2	72.5	70.9	72.3	70.8
17	.292	.152	.286	.533	.403	.575	78.3	73.7	72.6	71.0	70.6	69.1
18	0	.155	.312	0	.475	.579	0	79.4	71.8	0	67.8	70.0
19	.307	.202	.289	.541	.505	.583	73.0	74.7	71.4	71.3	68.5	68.9
20	.281	.193	.271	.580	.419	.494	73.6	74.0	72.2	68.7	71.6	71.7
21	.289	.153	.260	.566	.374	.522	75.3	73.0	71.3	69.6	71.8	70.2
22	.284	.134	.262	.530	.390	.501	75.6	74.1	72.0	70.8	70.4	71.1
23	.291	.211	.339	.558	.462	.621	74.3	72.2	70.1	70.0	70.6	69.4
24	.341	.285	.374	.668	.567	.651	75.6	71.0	70.7	67.5	69.4	69.6
25	.402	.327	.421	.791	.621	.739	74.6	79.2	69.7	64.7	68.9	67.9
26	.420	.314	.409	.832	.653	.731	74.0	80.1	71.2	63.6	67.0	67.7
27	.392	.280	.381	.770	.572	.680	.6	80.1	71.0	65.2	69.0	68.7
28	.365	.260	.385	.708	.494	.592	77.0	82.0	75.7	66.8	71.3	72.3
29	.365	.288	.401	.586	.509	.629	78.5	82.4	74.6	71.8	71.8	71.5
30	.408	.307	.380	.690	.589	.691	78.5	80.0	71.0	69.4	69.4	68.2
31	0	0	0	0	0	0	0	0	0	0	0	0
	28.342	28.223	28.336	27.663	27.549	27.609	77.1	80.0	72.6	67.7	67.2	69.7

Gangaroowa near Kandy, Ceylon.

Humidity.			Max. in Sun's Rays at 12 o'clock.	Minimum on Grass.	Maximum in Air.	Minimum in Air.	Difference.	Mean.	Dew in Grs. per sqr. ft.	Evaporation in Grs. per sqr. ft.	Rain. At 4½ feet.			Rain. At 39 feet.		
A. M. 9.30	P. M. 3.30	P. M. 10.0									A. M. 9.30	P. M. 10.0	Total.	A. M. 9.30	P. M. 10.0	Total
631	492	800	150.9	62.5	85.8	68.2	17.6	77.0	273	5995	0.000	0.000	0.000	0.000	0.000	0.000
639	314	865	151.1	59.9	86.1	66.3	19.8	76.2	271	7935	0.000	0.000	0.000	0.000	0.000	0.000
560	322	830	153.6	59.9	85.8	65.9	19.9	75.8	144	7200	0.000	0.000	0.000	0.000	0.000	0.000
670	528	716	149.9	67.5	84.2	71.5	12.7	77.9	70	1975	0.000	0.000	0.000	0.000	0.000	0.000
636	469	890	153.2	60.1	86.8	65.6	21.2	76.2	240	5965	0.000	0.046	0.046	0.000	0.044	0.044
678	883	915	155.8	64.9	84.7	68.3	16.4	76.5	187	3385	0.000	0.585	0.583	0.000	0.561	0.561
762	650	925	155.0	64.2	82.8	67.7	15.1	75.2	0	3590	0.003	0.000	0.003	0.001	0.000	0.001
682	552	925	151.2	63.2	83.6	66.3	17.3	75.0	234	4650	0.000	0.001	0.001	0.000	0.001	0.001
718	482	885	150.8	65.0	85.7	67.7	18.0	76.7	206	5430	0.000	0.000	0.000	0.000	0.000	0.000
670	619	890	155.3	67.8	86.6	70.9	15.7	78.7	202	4450	0.000	0.001	0.001	0.000	0.000	0.000
682	630	935	147.2	64.9	82.4	68.3	14.1	75.4	156	3135	0.000	0.479	0.479	0.000	0.490	0.490
738	672	942	154.3	68.3	83.9	69.7	14.2	76.8	173	4135	0.003	0.221	0.224	0.003	0.221	0.224
7[illegible]	595	915	145.1	67.6	82.3	69.3	13.0	75.8	173	4195	0.000	0.000	0.000	0.000	0.000	0.000
698	510	900	148.8	64.5	85.0	68.2	16.8	76.6	180	5670	0.000	0.000	0.000	0.000	0.000	0.000
730	552	946	152.0	63.1	84.6	67.8	16.8	76.2	252	5140	0.000	1.982	1.982	0.000	2.019	2.019
762	797	942	153.0	67.0	82.8	69.8	13.0	76.3	173	2820	0.000	0.235	0.235	0.000	0.218	0.218
778	900	890	147.7	68.3	82.1	70.3	11.8	76.2	165	3030	0.000	0.654	0.654	0.000	0.618	0.618
0	674	912	140.8	69.4	80.6	71.3	9.3	76.0	90	4450	0.000	0.109	0.109	0.000	0.093	0.093
940	810	920	98.4	70.2	75.3	70.2	5.1	72.7	0	1830	0.132	0.021	0.153	0.121	0.015	0.136
850	920	983	133.0	68.2	77.0	70.4	6.6	73.7	110	2990	0.002	0.146	0.148	0.001	0.134	0.135
825	958	965	155.3	70.0	80.4	70.7	9.7	75.6	43	2180	0.002	4.777	4.779	0.001	4.755	4.756
850	885	970	144.3	67.3	0	0	0	0	0	2275	0.011	0.039	0.050	0.001	0.033	0.034
865	947	976	127.8	66.8	78.0	69.5	8.5	73.7	210	1565	0.000	0.887	0.887	0.000	0.880	0.880
761	943	964	146.0	64.9	79.2	67.9	11.3	73.6	273	2625	0.000	1.427	1.427	0.000	1.423	1.423
712	706	940	137.5	62.0	79.8	66.2	13.6	73.0	340	5410	0.000	0.000	0.000	0.000	0.000	0.009
700	639	882	132.2	58.0	79.8	62.4	17.4	71.1	460	8390	0.000	0.000	0.000	0.000	0.000	0.000
682	686	922	140.0	61.0	80.5	65.2	15.3	72.8	415	6980	0.000	0.000	0.000	0.000	0.000	0.000
710	704	890	139.0	62.8	82.0	67.3	14.7	74.7	370	5810	0.000	0.000	0.000	0.000	0.000	0.000
793	704	900	141.7	66.8	83.2	71.2	12.0	77.2	170	5260	0.00[illegible]	0.000	0.000	0.000	0.000	0.000
734	698	904	139.2	66.9	82.6	70.3	12.3	76.4	240	5060	0.000	0.006	0.006	0.000	0.007	0.007
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
731	675	909	145.0	65.1	82.5	68.4	14.1	75.5	5820	4560	0.153	11.614	11.767	0.128	11.512	11.640

Gangaroowa near Kandy, Ceylon.

	A. M. 9.30							P. M. 3.30						
April, 1864.	Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.	Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.
1	0.5	0	0	0	1.7	0	2.2	0	0	0	0.1	7.5	0	7.6
2	0	0	0	0	0.4	0	0.4	0	0	0	0.1	0.8	0	0.9
3	0.4	0	0	0	1.0	0	1.4	0	0	0	0	5.0	0	5.0
4	0	0	6.5	0	3.3	0	9.8	1.0	0	0.2	0	8.8	0	10.0
5	0	0	0	0	1.0	0	1.0	0	0.6	0	0	0	8.6	9.2
6	2.5	0	0	0	2.5	0	5.0	0	0	0	0.1	0	9.9	10.0
7	3.0	0	0	0	2.0	0	5.0	0.4	0	0.7	6.0	0	2.0	9.1
8	0.5	0	0	0	0.3	0	0.8	3.5	0	0	0	0	3.8	7.3
9	7.3	0	0	0	1.2	0	8.5	0	0	0	0	0	9.0	9.0
10	0.1	0	0	0	2.4	0	2.5	0	0.4	0	0	0	9.0	9.4
11	0.5	0	0.3	0	2.0	0	2.8	0.7	0	0.3	0	0	9.0	10.0
12	6.8	0	0.1	0	0.1	0	7.0	0	0	0.1	0.4	0	8.8	9.3
13	4.0	0	1.5	0	3.3	0	8.8	0	6.7	0	0	0	3.3	10.0
14	10.0	0	0	0	0	0	10.0	8.3	0	0	0.2	1.5	0	10.0
15	9.2	0	0	0	0.4	0	9.6	1.2	1.3	0	0	2.5	0	5.0
16	3.7	0	2.0	0	3.3	0	9.0	0	0.2	0.1	0	9.7	0	10.0
17	8.4	0	0	0	1.2	0	9.6	0	8.5	0.2	0	1.3	0	10.0
18	0	0	0	0	0	0	0	0	3.5	1.5	0	0	4.5	9.5
19	0	7.8	1.2	0	0	1.0	10.0	0	0.6	0	0	0	9.4	10.0
20	0.2	0	0	0	0	9.8	10.0	0	0	2.0	0	0	8.0	10.0
21	0	0	8.0	0	0	2.0	10.0	0	0	0	0	0	10.0	10.0
22	0.2	0	9.3	0	0	0.4	9.9	0	0.2	0	0	0	9.8	10.8
23	0	9.0	0	0	0	1.0	10.0	0	0.2	0	0	0	9.8	10.0
24	0.4	0	0.1	0.2	0.7	0	1.4	0	2.0	0	0	0	8.0	10.0
25	4.0	0	0	0	0	0	4.0	4.5	0	0	0	1.2	0	5.7
26	0	0	0	0	0	0	0	0.8	0	0	0	0.8	0	1.6
27	0.1	0	0	0	1.2	0	1.3	1.8	0	0	0	1.5	0	3.3
28	0	0	0	0	2.5	0	2.5	0	0	0	0	5.0	0	5.0
29	0	0	0	0	0	0	0	0	0.2	0	0	8.0	0	8.2
30	5.0	0	0	0.1	1.7	0	6.8	0	1.5	0	0	0	8.5	10.0
	2.5	0.6	1.1	0.0	1.2	0.5	5.9	0.8	0.9	0.2	0.2	1.8	4.3	8.2

Gangaroowa near Kandy, Ceylon.

P. M. 10.0							Ozone.		9.30 A.M. Direction of wind.		Velocity in feet per Second.
Cirrus.	Cirro-Stratus.	Cirro-Cumulus.	Cumulus.	Cumulo-Stratus.	Nimbus & Stratus.	Total.	6 A. M.	6 P. M.	Vane.	Lower Clouds.	
0	0	0	0	8.0	0	8.0	0	1	Variable	Variable	1.67
0	0	0	0	0.7	0	0.7	0	0	Variable	E	2.73
0	0	0	0	0	0	0	0	0	N E	E N E	6.16
0	0	0	0	3.3	0	3 3	1	1	W	N E	3.34
9.0	0	0	0	1.0	0	10.0	0.5	1.5	Variable	Calm	2.16
0.3	0	0	0	0	8.5	8.8	0	3	Variable	Variable	2.02
0	0	0	0	1.0	0	1.0	0	1	W by N	Variable	5.11
0.5	0	0	0	1.5	0	2.0	0	0	W by	Variable	0.00
0	0	0	0	0	9.0	9.0	0	0.5	Variable	Variable	0.35
0	0	0	0	9.0	0	9.0	0	1	Variable	Calm	2.29
3.0	0	0	0	0	7.0	10.6	0	1	W by	Variable	2 55
1.5	5.0	0.2	0	0	0 3	7.0	0	1	Variable	None	2.20
8.4	0	0	0	1.0	0	9.4	0	1	S by W	E S E	7.57
0	0	0	0	2.0	0	2.0	0	1.5	N E by	None	1.58
0	0	0	0	9.6	0	9.6	0	1	N N W by	E by S	2.64
0	0	10.0	0	0	0	10.0	0.5	1	W by	E	2.11
0	0	9.8	0	0.2	0	10.0	0	2	N by	E N E	0.79
0	0	0	0	0	10 0	10 0	2	2	.. .	... ..	0
0	0	10.0	0	0	0	10.0	0	1.5	E N E by	?	0.18
0	0	1.7	0	0	8.0	9.7	3	1	N N E	?	1 06
0	0	0	0	0	10.0	10.0	0	0.5	Variable	E	0.18
8.5	0	0.3	0.2	0	0	9.0	0	1	S W	Calm	2.82
0	9.8	0	0	0.2	0	10.0	0	1	S W by W	W by	1.76
0	10.0	0	0	0	0	10.0	0	0	W	S by (?)	5.28
0	0	0	0	0	0	0.0	0	0.5	W N W	None	3.96
0	0	0	0	0	0	0.0	0.5	0	......	......	0
0	0	0	0	0.7	0	0.7	1	1	W	S W by S	10.91
0	0	0	0	8.5	0	8.5	0.5	1	S S W	S by W	7.57
1.0	0	0	0	1.0	0	2.0	1	1	.. ..	......	0
0	0	0	0	2.0	0	2.0	1	2	S W by N	S W by W	11.97
1.1	0.9	1.1	0.0	[illegible]	1.8	6.6	0.4	1.0	......	.....	3.38

Gangaroowa near Kandy, Ceylon.

April, 1864.	3.30 P. M. Direction of wind. Vane.	3.30 P. M. Direction of wind. Lower Clouds.	Velocity in feet per Second.	10.0 P. M. Direction of wind. Vane.	10.0 P. M. Direction of wind. Lower Clouds.	Velocity in feet per Second.
1	W S W	Variable	6.25	Calm	Too dark	0.00
2	E by N	Variable	14.08	N W by N	Too dark	3.17
3	N E	Variable	7.39	W S W	W by	1.94
4	N W	Variable	6.25	S W	Calm	3.08
5	W N W	Variable	7.83	N N W	Calm	2.73
6	N E	E N E by Calm	2.38	N W by	Too dark	1.67
7	W S W by	N N E by	3.78	N N W by	?	0.02
8	W N W	Variable	7.83	Calm	Too dark	0.00
9	W by N	Variable	6.86	N W	Too dark	0.62
10	S	Variable	12.41	N W by W	Too dark	0.09
11	N E by E	E	7.48	N by	Calm	0.10
12	W	Calm	10.38	Variable	Too dark	0.18
13	S W by W	Variable	9.06	N W	E N E	2.46
14	W S W	E S E (?)	7.83	N W	N E (?)	1.94
15	N W	E by S by	7.83	N N W	N by E	0.00
16	S by (?)	Variable	7.48	N W	None	2.29
17	E N E by	Calm	1.50	E N E by	Too dark	4.93
18	N N E by	E	6.42	W S W	Too dark	3.17
19	E	Calm ?	6.07	Calm	None	0.00
20	E N E	E N E	0.26	N W	E S E	0.26
21	Variable	Calm	2.29	N E	?	6.51
22	S S E	W by	1.14	W N W	None	0.88
23	E S E	Calm	0.26	Variable	Calm	0.00
24	W by	S by	0.88	N by	None	0.70
25	W by S	W	14.87	N W by W	None	1.50
26	W by N	W S W by	9.68	W by	None	0.35
27	W	W	16.72	W N W	Too dark	1.85
28	W by S	Calm	12.67	W	Too dark	8.10
29	W	S W by	19.18	S W by	?	0.26
30	S by	Calm.	6.34	W N W	Too dark	3.87
	......	......	7.45	......	......	1.75

GANGAROOWA NEAR KANDY, CEYLON.

Distance in Miles in 24 Hours.	Lightning and Thunder.
49.94	Between 7 & 8 P. M. brilliant L R to N N W—N.
74.52	[L R to W by S—W N W.
64.85	Between 9 & 10 P. M. L & Th. barely heard to W N W—N W & brilliant
45.31	At 4 P. M. one clap of Th. heard. [fore even L & Th. not far.
61.38	In fore & afternoon & fore even Th. at even L & Th. dist. to S W & in early
49.87	At 2 P. M. L & Th. not far at 3.30 P. M. L & Th. to N W & in fore even L & Th. dist. a few miles at 8 P. M. vivid L R to W—W S W.
50 63	At 2 P. M. Th. in fore even L & Th. in N W quarter between 7 & 8 P. M. L R to N—N N W & S S W.
31.36	[even L R to S by W, S S W & N N E.
39.55	At 3.30 P. M. Th. & shortly one flash L to S E by E dist. 4 miles. In after
38.57	From 2.30 to 3.30 P. M. L & Th. to E N E dist. 1 or 2 miles. At even frequent L in a mass of Cumulus to N W.
31.10	At noon, after 2 P. M. & in fore even Th. At even two flashes L with Th. to W, W N W dist. 7 & 12 miles, between 7 & 8 P. M. L R to W N W, N N W & S W & S after 9 P. M. L R to W—S W, S—S E & dist. Th.
46.21	After 2.45 P. M. Th. & after 4.30 till even L & Th to S W—N dist. several miles. In after even frequent L & Th. more or less dist. & at 10 P. M. L R to W N W & E N E.
55.02	At 3.30 P. M. & in all fore even Th.—at 8 P. M. L R to W N W.
49.02	
49.57	Between 7 & 8 P. M. L & Th. dist. several miles. [L R to N N W.
29.56	Between 1 & 2 P. M. Th. in fore even L & Th. dist. several miles & at even
37.71	At 2 P. M. Th. & shortly L with Th. not far dist. At 10 P. M. L R to E.
88.93	Between 2 & 3.30 P. M. Th.
40.26	
58.82	
32.04	From 2.30 P. M. to 6 P. M. L with Th. not far dist. some flashes very near.
33.82	In afternoon Th. L R at even in Cumulus to N W by W, at 8.30 to E & at 10 P. M. L & L R in Cumulus to S W by S, S W by W & N W.
22.45	At 1.30 P. M. Th. from 2 to 3 P. M. frequent L & Th. dist. 1 or 2 miles & more.
30.67	From 1.30 to 2 P. M. L & Th. some flashes quite close, at 3.30 P. M. dist. Th.
70.51	
122.03	
112.39	
104.38	[8 P. M. bright L R to W S W.
102.54	Between 7 & 8 P. M. L R to N E & brilliant L in Cumulus to E by S after
93.16	At 1 P. M. & after Th. at 3.30 P. M. L & Th. dist. several miles, & in fore even L & Th. in all, N half of sky dist. a few miles.
57.24	

GANGAROOWA NEAR KANDY, CEYLON.

April, 1864.	GENERAL REMARKS.
1	Fog & very damp at morn; hot & dry day, sultry in after even, heavy Cum. Str. & cover. large part of sky for rest of the day. [squally in forenoon.
2	Cool & fresh at morn, warm to very hot & dry, not much cloud, wind rather
3	The same as above, but at even heavy threaten. clouds in N W quarter.
4	Warm to very hot & dry but sultry & oppressive all day; more or less Cum. Str. all day, very threaten. in fore even.
5	Cool at morn, warm to very hot, dry & oppressive till 4 P. M. when some rain & after pleasant. Heavy Nim. gatherd. in afternoon.
6	Cool damp morn, warm to hot & oppressive till the rain, then raw & damp heavy rain in afternoon & afterwards light rain. [but broke up without rain.
7	Cool damp morn, fine & clear till Noon, Nim. gathered in afternoon & fore even,
8	Cool fresh morn, warm to hot pleasant day, Nim. gather. in afternoon covered the sky in fore even but broke up with only a few drops rain.
9	As on previous day. [but broke up with a little rain.
10	Mild to very hot & oppressive day, heavy Nim. in afternoon & fore even,
11	Fine & pleasant till 10 A. M. heavy rain for an hour in forenoon, Nim. covering the sky afternoon, fore & afternoon & some rain.
12	Raw & damp with fog till 7 A. M. warm to hot, at times muggy, at times pleasant, after Noon Nim. & rain in fore & after even.
13	Very damp morn, warm to hot & pleasant day. In fore even Nim. covered the sky but only a few drops rain.
14	Very damp with fog at morn, cloudy but fine, warm to hot, dry & pleasant day.
15	Damp morn, fine, dry & pleasant till even, very heavy rain fr. 6.45 till 8 P. M. & then again fine. [3.0 P. M. & 4.30 to 9.0 P. M.
16	Mild to very hot, damp & oppressive day, Nim. at Noon & after, rain 2.30 to
17	Fog at morn, mild to hot, damp & oppressive day, heavy Nim. gathered at noon, rain 2.30 to 3 & 4.30 to 9 P. M. [from E rain fr. 4.15 till after 8 P. M.
18	Mild to hot & pleasant till fore even, then damp Nim. more or less passing over
19	Mild to raw, damp cloudy day, light rain fr. 2 A. M. till 9 A. M. showers in fore & after Noon. [light showers.
20	Mild to warm, damp day, Nim. more or less all day, generally fr. E N E or E
21	Mild & very damp day, heavy Nim. gatherd. in afternoon, fr. 2.30 to 3.30 P. M. 3 inches rain fell, rain all fore & after even. [& in afternoon & fore even.
22	Mild to warm, damp, muggy & cloudy day, light rain between 10 P. M. & 6 A. M.
23	Very damp, at times raw, oppressive day, Nim. gathered in forenoon, heavy rain 1.30 to 3.30 P. M. & light rain in fore even. [light rain all fore & after even.
24	Oppressive at noon, raw and damp after the rain. heavy rain fr. 1.30 till 3 P. M.
25	Very damp with fog at morn, mild to warm, dry & fresh day.
26	Cool, fresh morn, mild to hot, dry, pleasant day, sky nearly cloudless.
27	As on previous day. [less clouded.
28	As on previous day till afternoon, then sultry & oppressive, & sky more or
29	Muggy morn, fine, hot, pleasant, more or less cloudy day, sultry after even.
30	Mild to hot pleasant day, heavy Nim. in afternoon & fore even, but they broke up with only a little rain here.
31	

Solar Halo seen on 6th, 7th, 12th, 1[illegible]th, 15th, 22d, 23d, Lunar Halo seen on 13th.